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RESPONSE ACTION CONTRACT

U.S. EPA Contract No. 68-W7-0039

SITE HEALTH AND SAFETY PLAN

**Work Assignment 004-RICO-089R
Vasquez Boulevard/Interstate 70
Remedial Investigation**

JULY 22, 1999

Prepared By:



MORRISON KNUDSEN CORPORATION

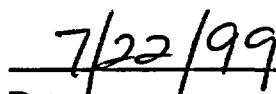
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**SITE HEALTH AND PLAN
WORK ASSIGNMENT 004-RICO-089R
VASQUEZ BOULEVARD/INTERSTATE 70
DENVER, COLORADO
REMEDIAL INVESTIGATION**

REVIEWS AND APPROVALS



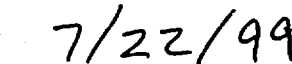
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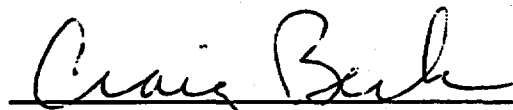
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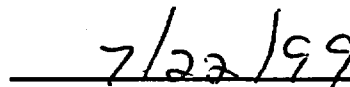
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Date

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1.0 Introduction

1.1 Objective

This document is the Site Safety and Health Plan (SSHP) that will be used for the Remedial Investigation Phase III Soil Sampling of the Vasquez Boulevard/Interstate 70 Response Action Contract. The SSHP will be implemented and followed by Morrison Knudsen Corporation (MK) and MK subcontractor personnel conducting soil and dust sampling activities of residences within the site boundaries. The objective of the SSHP is to provide guidance to maintain safe working conditions at the site. This plan will be reviewed by all site workers during site entry training. All activities should be conducted so that the safety and health of the project personnel, residents, and the environment are completely protected. The protection of workers and residents, and environmental safety and health are key considerations during project design and are essential during implementation of the field activities.

1.2 Policy Statement

All work will be performed in accordance with applicable federal, state and local regulations and recommendations; the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Requirements of 29 CFR 1910 and 29 CFR 1926; U.S. Environmental Protection Agency (USEPA) requirements; and the MK *Safety and Health Program Description for Hazardous Waste Operations*. It is MK's policy to provide a safe and healthful work environment for all its employees. MK considers no operation or administration activity to take precedence over the prevention of an injury and illness. Safety takes precedence over expediency or shortcuts. At MK we believe every accident and every injury is avoidable, and we will take every reasonable step to reduce the possibility of injury, illness, or accident.

Operational changes that could affect the health or safety of personnel, the community, or the environment will not be made without prior approval of the MK Program Manager, MK Site Manager, MK Project Health and Safety Manager, and the USEPA.

The provisions of this plan are mandatory to all MK personnel and MK subcontractors assigned to the project. MK requires all visitors (including but not limited to MK and USEPA personnel) to any of the work sites to also abide by the provisions of this SSHP.

1.3 References

This SSHP follows the guidelines established in the following documents:

- Title 29 of the Code of Federal Regulations, Part 1910, General Industry Standards, Occupational Safety and Health Administration (OSHA)
- Title 29 of the Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction, Occupational Safety and Health Administration (OSHA)
- U.S. Environmental Protection Agency Contract No. 68-W7-0039. Work Assignment 004-RICO-089R Vasquez Boulevard/Interstate 70 Remedial Investigation.

Contents of this plan are consistent with the Morrison Knudsen Corporation *Safety Procedures and Guidelines Manual*, *Safety and Health Program Description for Hazardous Waste Operations*, and *Industrial Hygiene Procedures Manual*. Copies of this SSHP and the referenced documents will be kept in the Field Office and in site vehicles, where appropriate, and will be made available for use by all personnel.

1.4 Modifications to the SSHP

Permanent modifications to the SSHP will be undertaken in the following manner:

- Draft changes to the SSHP will be prepared by the MK Project Health and Safety Manager (HSM) or his/her designee.
- Draft changes to the SSHP will be reviewed and commented on by the MK Program Manager (PM) and MK Site Manager (SM) and/or their designees.
- The Project HSM will incorporate comments, as appropriate, and issue a revised draft final SSHP.
- The revised SSHP will be submitted for approval and signature by the PM, SM and Project HSM.
- Depending on the extent of revisions, either individual pages or the entire SSHP will be issued as Rev. x.

1.5 MK Subcontractors Statement of Policy

MK requires that a consistent Site Safety and Health Program be employed during all activities of its employees, agents and subcontractors. This SSHP presents the minimum requirements acceptable to MK for efforts conducted by its subcontractors.

In performance of activities for MK, a commitment shall be established by the subcontractor for accident and fire prevention. Safety shall take precedence over schedule and production to eliminate personal injuries, occupational illnesses and damage to equipment or property, as well as protecting the general public whenever they may be affected by the subcontractor's work.

Subcontractor management and supervision shall recognize the responsibility for compliance to all established codes, regulations, standards and procedures. Enforcement action is mandatory, therefore, every subcontractor superintendent will be held accountable for the safety performance demonstrated by the employees under his/her supervision.

In performance of the work, the subcontractor shall comply with all applicable rules and regulations related to safety and health including, but not limited to, those of the Occupational Safety and Health Administration and the USEPA. The subcontractor shall give all notices required by the applicable rules and regulations. The subcontractor shall also comply with all verbal and written safety requirements of MK and the USEPA.

A training program shall be effectively established for each employee soliciting their full cooperation with a belief that accidents can be prevented.

The subcontractor shall have responsibility for the safe use, storage, labeling, and disposal of any chemicals, refuse, waste, or other materials generated or used in the performance of the work in accordance with this Safety and Health Plan.

1.6 Nonconforming Conditions and Practices

1.6.1 Safety Violations

MK and subcontractor personnel have the responsibility to stop subcontractor personnel or activities when violations of safety, health, or environmental requirements are observed until such violations are corrected. Such violations may include, but are not limited to, the following examples:

- Lack of proper PPE as specified in this plan (e.g., safety glasses, gloves and steel toe boots).
- Improper or incomplete decontamination of personnel and equipment/tools.
- Unavailability of specified emergency equipment (fire extinguishers, emergency eyewash, and first-aid supplies).
- Lack of GFCI protection, when such equipment is required.
- Unlabeled or improperly labeled containers.
- Failure to report a spill of an unidentified substance or reportable quantity of a hazardous material.
- Flagrant violations of the health and safety requirements of this health and safety plan and applicable OSHA regulatory requirements.

1.6.2 Disciplinary Actions

When disciplinary action is required, the party will be identified. If two Safety Violation Notices (Appendix A) have been written by MK against an employee in one year, the employee shall be removed from the project for three work days. If an employee receives three notices from MK in one year, MK will permanently remove the employee from the project. In addition, MK may immediately barr any employee from the site without notice for serious violations of health and safety requirements. Examples of serious violations include, but are not limited to:

- Unauthorized use of vehicles or equipment
- Theft of property
- Fighting
- Vandalism
- Possession of contraband substances or prohibited articles, e.g., firearms.

1.6.3 Drug Screening

All MK temporary employee candidates will be screened for drugs prior to hire. Subcontractor personnel will be required to successfully pass a drug screen within one week prior to first working on site, as discussed in Section 16 of this SSHP.

1.7 Incident Reporting

Employees are responsible for immediately reporting to the MK Field Supervisor any event that may adversely impact personnel or the environment, or result in damage to equipment, regardless of the severity. All "near-misses" must also be reported. A "near-miss" is an event that did not, but had the potential to, cause injury or damage.

It is the responsibility of the MK Field Supervisor to investigate all injuries, property damage, environmental events, and near-misses. The primary purpose of accident investigations is to prevent recurrence.

After any injury, including those requiring only minor first-aid, MK and subcontractor employees shall immediately notify the MK Field Supervisor. For injuries/illnesses requiring more than minor first aid and for all incidents causing property damage, a Supervisor-Report-Of-Injury Form must be completed by the Field Supervisor and submitted to the MK Site Manager and Health and Safety Manager within three days.

Except as may be necessary to protect personnel and to minimize environmental or equipment damage, the accident/incident scene shall be preserved so as to allow an accurate investigation as to what occurred, the causes, and corrective measures to prevent recurrence.

1.8 Bulletin Board

A bulletin board is provided in the site trailer. The bulletin board shall be utilized for the posting of required OSHA information, MK or subcontractor safety information, emergency telephone numbers, safety posters, and the shortest routes to the nearest medical center emergency room.

2.0 Organizational Authority And Responsibilities

2.1 Program Manager (PM)

The Program Manager is responsible and accountable for all program activities. This individual has power of attorney from MK for this program and is authorized to commit the Corporation as necessary to fulfill the requirements of this contract. The PM provides:

- Overall program leadership and direction
- Compliance with program scope, schedule, and budget
- Program technical quality
- Liaison with the USEPA
- Change order control
- Program health and safety enforcement
- Subcontractor management
- Project support staff direction and coordination

2.2 Site Manager (SM)

The SM reports directly to the PM. This individual is responsible and accountable for all aspects of project specific performance and is the point of contact for the USEPA Remedial Project Manager. The SM provides:

- Cost, schedule, and quality accountability for the project
- Frequent and open communications with the USEPA Representatives
- Resources to implement the Work Plan and maintaining compliance with the SSHP and the Quality Assurance Project Plans
- Staff and subcontractor direction
- Technical and project data and reports
- Recommendations for revisions to Work Plan to improve quality, increase productivity, reduce cost, or enhance safety and health protection

2.3 Field Supervisor (FS)

The FS reports directly to the SM and will be responsible and accountable for all soil sampling activities. The FS provides:

- Direction/supervision for all MK and subcontractor site activities in accordance with MK policies and project requirements
- Coordination of MK field, waste management, soil shipment, safety and health, and field data management activities
- Compliance with local, state and federal permitting requirements for field activities
- Technical monitor for all field subcontracts
- Interface and coordination with the USEPA during all field activities
- Compliance with the project schedule and performance budget for environmental and technical support activities
- Identification of scope, technical, quality, and safety and health issues
- Daily review of field documentation for completeness, accuracy, and timeliness

2.4 Project Health and Safety Manager (HSM)

The Project HSM is the MK Denver Operations Health and Safety Program Manager and serves as a technical advisor to project management on safety and health planning and problems. Specifically, the Project HSM provides:

- Preparation of the MK Site Specific Safety and Health Plan (SSHP) which complies with MK, USEPA, OSHA, and other legal requirements
- Hazard analyses
- Periodic monitoring of SSHP implementation by site personnel
- Supervision and management of the Site Health and Safety Officer and other project safety and health personnel
- Personnel resources for proper field coverage for health and safety
- Review of contract documents to ensure the incorporation of appropriate safety and health requirements
- Coordination of all project safety and health training and medical monitoring

2.5 Site Health and Safety Officer (SHSO)

The SHSO reports to the HSM and is responsible and accountable for implementation of the SSHP. The SHSO provides:

- Technical guidance to the SM and FS on the implementation, monitoring and enforcement of the project SSHP
- Applies recognized policies, procedures, and work practices to promote MK and the project safety and health program
- Administers and coordinates, as necessary, medical and emergency first aid services and programs
- Conducts air monitoring required in the SSHP
- Oversight of all site project safety and health training and medical monitoring
- Authority to stop work, if necessary, to protect personal and environmental safety and health
- Investigates injuries, conditions, and incidents that do, or could, involve actual or potential liability
- Assists project supervision in the inspection of equipment, facilities, and work in progress
- Recording and reporting of injuries or incidents in accordance with MK policies
- Emergency response coordination until professional help arrives

2.6 Contract Financial/Administration Manager

The Contract Financial/Administration Manager is responsible and accountable for all procurement and contractual matters for both the prime contract and the subcontracts. This individual serves as the Contracting Officer for all subcontracts issued by MK. The Contract Financial/Administration Manager provides:

- Prime contract administration
- Development and maintenance of an approved bidders list
- Management of the total subcontracting process including purchasing, subcontract package preparation, bidding, selection, negotiation, issuance, and administration
- Management of all purchasing actions
- Management of the Small and Small Disadvantaged Business program
- Management and coordination of business functions including accounting, financial, office administration, and material control

2.7 Subcontractor

The subcontractor will be advised of the provisions of the project safety and health program, of client stipulations, and of contractual obligations. The subcontractor will also be advised of its obligation to comply with applicable statutory safety and health laws, regulations, and rules.

The subcontractor shall furnish all reasonable information concerning safety of his operations on the project as may be required by MK.

Directives and general guidelines for subcontractor safety and health programs shall be provided to each company prior to job start-up. Minimum requirements for subcontractors shall be to:

- Inform all their personnel of the project safety and health program and of their responsibility to work at all time in a safe and healthful manner in accordance with the SSHP.
- Maintain all equipment and tools in a safe condition.
- Cooperate with MK and the USEPA in maintaining a safe and healthful workplace.
- Conduct and participate in safety and health inspections.

2.8 All Personnel

All personnel are responsible for understanding and complying with all site safety and health requirements. While MK is responsible for providing a safe work place and is responsible for ensuring compliance with the requirements of this SSHP, each person is responsible for completing tasks in a safe manner, for reporting any unsafe acts or conditions to their supervisor and/or the MK FS and/or the SHSO, and discontinuing assigned work until unsafe conditions are corrected. All personnel are responsible for continuous adherence to these safety and health procedures during the performance of their work. Site personnel are subject to progressive discipline and may be terminated for blatant or continued violations.

2.9 Visitors

All visitors and personnel must comply with the provisions of this SSHP and all applicable federal, state, and local regulations. While MK is ultimately responsible for providing a safe work place and is responsible for ensuring compliance with the requirements of the SSHP, each person, including visitors, visiting the job site is responsible for completing tasks in a safe manner and for reporting any unsafe acts or conditions to their supervisor, the MK FS or the SHSO. Personal protective equipment (PPE) for project personnel will be stored in the site trailer or storage building. PPE will be issued to visitors only as required by their task-specific activities.

3.0 Site Description and Contaminant Characterization

In the Spring of 1988, a large scale surface soil sampling program was implemented to determine the extent of heavy metal contamination within the Vasquez Boulevard and I-70 Site. Although the site boundaries have not been delineated as of yet, the study area where samples were collected in the Spring of 1988 consists of a neighborhood of residential and commercial buildings in the City of Denver, Colorado. Only residential yards within the study area were sampled. The study area parallels and is bounded on the west by the South Platte River. The study area is bounded on the east by Colorado Boulevard. Northern and southern boundaries for the study area are East 56th. Avenue and Martin Luther King Boulevard. See Appendix B for a site map.

Each of the nearly 2400 surface soil sample locations were collected individually (grab sample), sieved to particles less than 2 mm (bulk fraction) and the bulk fraction was analyzed for three metals: arsenic, cadmium and lead. The range of concentrations for these soils were:

Analyte	Concentration Range (ppm)
Arsenic	<44-5600
Cadmium	<96-120
Lead	<28-8000

Local smelters in the Vasquez Boulevard and I-70 area have reportedly produced both stack emissions and solid waste by-products that could potentially have been transported to surrounding areas through a variety of mechanisms including deposition of stack emissions or solid waste by wind transport, rain events, etc. Alternative sources other than smelting by-products for these materials may exist. The remedial investigation will involve collecting surface soil samples from additional residential properties and alleys, as well as indoor dust sampling.

Work tasks that will be performed during the Remedial Investigation include:

- Mobilization
- Soil sampling outside residences
- Dust sampling inside residences
- Analysis of samples inside site trailer using x-ray fluorescence
- Demobilization

4.0 Safety and Hazard Assessment and Risk Analysis

This section describes the chemical, biological, and physical hazards that are associated with the Vasquez Boulevard/Interstate 70 Remedial Investigation. The hazard assessment and risk analysis are based upon information provided by the U.S. Environmental Protection Agency (USEPA) and previous studies, and are subject to change if further information indicates other hazards are present or tasks or operations are modified from what is described in the previous section. The chemical hazards associated with these materials are described in the following sections.

4.1 Chemical Hazards

4.1.1 Site-Related Chemical Hazards

The primary chemical of concern is arsenic. A secondary contaminant of concern is lead. The primary exposure pathways for arsenic and lead are through inhalation and ingestion of arsenic and lead contaminated soil and dust. These materials present a health hazard to site workers only when ingested or inhaled in sufficient dose to cause adverse effects.

Arsenic

OSHA PEL-TWA = 0.01 mg/m³

OSHA PEL-Action Level = 0.005 mg/m³

ACGIH TLV-TWA = 0.01 mg/m³

NIOSH TLV-C = 0.002 mg/m³

Arsenic enters the body primarily by inhalation and ingestion. Acute arsenic poisoning rarely occurs in an industrial setting and usually occurs via ingestion. Symptoms develop within 30 minutes to 4 hours of exposure. They are usually characterized by constriction of the throat followed by epigastric pain, vomiting and watery diarrhea. Blood may appear in vomitus and stools.

Lead

OSHA PEL-TWA = 0.05 mg/m³

OSHA PEL-Action Level = 0.03 mg/m³

ACGIH TLV-TWA = 0.05 mg/m³

NIOSH REL-TWA = 0.1 mg/m³

Lead enters the body primarily by inhalation and ingestion. In the respiratory tract, most lead compounds are absorbed rapidly and stored in nerve tissue so that poisoning can develop from long-term exposure to low doses. Poisoning can also develop slowly from ingestion via lead contaminated food, drink, or tobacco products. Prevention of lead poisoning is almost entirely a matter of good personal hygiene and housekeeping.

Acute lead poisoning usually manifests as gastroenteritis. Lead accumulates in the body; chronic lead poisoning is manifested by anemia, constipation, and abdominal pain. Accumulation in the peripheral nerves leads to wrist and ankle drop.

4.1.2 Site-Related Chemical Hazard Summary

The hazards posed by the on-site chemical contaminants will be controlled by minimizing worker contact through the use of good personal hygiene, engineering controls, and personal protective equipment (PPE). The specific types of PPE to be used are described in Section 8.0, PPE.

4.1.3 Work Activity-Related Chemicals

The only hazardous material expected to be brought onsite, other than fuel in vehicles, is the detergent Alconox. A copy of the Material Safety Data Sheet (MSDS) for Alconox is contained in Appendix C. An MSDS must be provided to the Health & Safety Manager prior to bringing additional hazardous materials onsite. The Health & Safety Manager will maintain an updated chemical inventory of the hazardous chemicals and will see that all personnel receive the proper Hazard Communication Program training.

4.2 Physical Hazards

The physical hazards associated with the project include:

- Use of passenger vehicles
- Use of sampling tools
- Heat stress, cold stress, other adverse weather conditions
- Obstacles or uneven terrain causing slips, trips, and falls
- Sharp objects causing cuts, contusions and lacerations
- Crunching, pinching, and falling objects

4.2.1 Heat Stress

- Appendix D contains specific, detailed information on heat stress control procedures.
- All employees are to be alert to the signs and symptoms of heat stress--extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, pale clammy skin.
- When heat stress symptoms are experienced, the employee is to immediately leave the work area, rest, cool off, and drink plenty of cool water.
- If the symptoms do not subside after a reasonable rest period, the employee shall notify the MK FS and seek medical assistance.
- The MK FS and/or HSM or their designee will be alert to signs of heat stress in site personnel and increase the frequency of breaks and fluid consumption as necessary.

4.2.2 Cold Stress

- Appendix E contains specific, detailed information on cold stress control procedures.
- All employees are to be alert to the signs and symptoms of cold stress-- extreme shivering, disorientation, white or gray color of the skin on the ends of fingers, nose, or ears.
- When cold stress symptoms are experienced, the employee is to immediately leave the work area, drink warm fluids or otherwise warm up, and change into dry clothes, as necessary.
- If the symptoms do not subside after a reasonable rest period, the employee shall notify the MK FS and/or HSM or their designee, and seek medical assistance.
- The MK FS and/or HSM or their designee will be alert to signs of cold stress in site personnel and increase the frequency of breaks and fluid consumption as necessary.

4.2.3 Tools and Equipment

General

- Owners' manuals of commercially available tools and equipment shall be kept in the site trailer.
- Personnel shall be trained in the safe operation of all tools used.

Inspections

- All tools and equipment shall be inspected by the user daily or before their use, with special attention given to power cords, the condition of hand auger handles, etc.
- If tools, material, or equipment are found to be defective, they shall be taken out of service immediately by tagging, destroying, or removing them from the project.
- Standard tags shall be used and shall consist of non-reusable nylon fasteners to secure tags.
- The tag shall be removed only when the equipment has been properly repaired and is declared serviceable by the subcontractor superintendent or his/her designee.
- Defective equipment tags shall be dated, sequentially numbered, and signed by the person tagging the equipment.
- Defective equipment tags shall also contain a description of the problem that requires the equipment, tools, or materials to be tagged.

Condition of Tools

- All equipment and tools shall be kept in good, safe condition and stored properly.
- Wrenches, including adjustable, pipe, end, and socket wrenches shall not be used when jaws are sprung to the point that slippage occurs.
- Tools having defects that will impair their strength or render them unsafe shall not be used and shall be taken out of service, as described above.

Hand Tools

- Impact tools such as samplers, wedges and chisels shall be kept free of mushroomed heads.
- Wooden and fiberglass handles of tools shall be kept free of splinters or cracks and shall be kept tight in the tool.

Power Tools

- All power tools and electrical equipment shall either be equipped with ground plugs or be double insulated.

4.2.4 Electrical Hazards

All operations shall comply with OSHA, NEC, and USEPA requirements.

Electrical Installation for Office/Support Facilities

- All electrical installations shall be undertaken by a licensed electrician familiar with local code requirements.
- Electrical installations must have MK approval before being energized.
- Electrical panels, boxes, etc., with open knockouts through which no service has been installed must be covered.
- The site trailer shall have a main service disconnect located at a readily accessible location outside and within 30 ft of the trailer, but not attached to the trailer.

- All breaker boxes, electrical receptacles, and feed lines shall be labeled to identify the circuits they are feeding or are being fed from.
- All breaker boxes and disconnects shall be provided with unobstructed access 36 inches in front of the unit.
- All 480-volt lines shall be clearly labeled.

Lighting

- All lights must be equipped with protective, nonconductive covers, and all light bulbs in light stringers must be shatterproof.
- Exposed, empty light sockets or broken bulbs are not permitted.
- Burned-out bulbs shall be replaced in a timely manner.

Electric Cords

- All cords, hoses, and leads must be kept out of walkways.
- Electrical cords and equipment shall not be hung or tied to steel or hung with wire unless a nonconductive material is used to insulate the cord from the metal. Plastic coated wire shall not be used to hang electrical cords.
- Electrical cords must be strung seven feet or more over walkways or along the sides of walkways.
- Cords, hoses, and leads are not to be exposed to vehicle or equipment traffic unless protected.
- Any damage detected on cords, hoses, and leads will require removal from the project. Flexible electrical cords shall not be spliced or have insulation repaired with tape.
- Replacement cord ends used for repair of flexible electrical cords shall be constructed of plastic or rubber and shall encapsulate all connections.
- Employees shall not plug or unplug flexible electrical cords while their hands are wet or when standing in accumulated water or other conductive liquids.

4.2.5 Underground Utilities

Due to the very shallow depth of soil sampling operations, there is a minimal potential to encounter underground gas, electrical, and telephone utilities. Where an obvious underground line or connection to a structure exists, surface soil sample collection shall take place 3 feet from the buried underground utility. Samplers should be aware of owner installed utilities that may service newer buildings on the property or added structures to the existing property structure. Even though the depth at which most soil samples will be collected are not going to reach into depths at which most utilities are buried, personnel should be aware of any recent changes on the property ground such as recently covered trenches, excavations and erosion.

4.2.6 Fire

Fire Extinguishers

- A 5-lb ABC dry chemical fire extinguisher must be located in all trailers as per National Fire Protection Association (NFPA) 10
- A 2.5-lb ABC dry chemical fire extinguisher must be located in all vehicles
- All fire extinguishers shall be inspected monthly, annually, and every 6 years in accordance with the NFPA 10 standard on fire extinguisher inspections.

- Inspection records shall appear on the fire extinguisher.

Fire Prevention Measures

- No hot work or open flames will be allowed in the work areas
- If there is a danger of accidental fire, a person shall be designated as fire watch and shall be dedicated solely to this effort during these operations and shall continue this duty for 30 minutes after such operations are completed.
- If a fire takes place, emergency steps may include evacuation of the work area and notification of the fire department and other appropriate emergency response groups if necessary.

4.2.7 Flammable/Combustible Liquids

Flammable liquids, other than petroleum fuels (e.g., gasoline or diesel fuel) used in vehicles shall not be used on this project. These fuels shall be placed directly into the vehicles. Fuels shall not be dispensed into portable containers.

4.2.8 Torch/Plasma Arc Cutting, Welding, and Open Flame Requirements

Torch/plasma arc cutting and welding will not be conducted on site during the Remedial Investigation. Equipment requiring these services will be sent to offsite facilities.

4.2.9 Motor Vehicles and Heavy Equipment

The subcontractor will comply with all aspects of 29 CFR 1926.600, 1926.601, and 1926.602 with regards to the safe operation and maintenance of motor vehicles and heavy equipment utilized during the Remedial Investigation.

Drivers Licenses/Other Qualification

- Only qualified, licensed MK or subcontractor employees may operate MK owned or leased vehicles. The FS shall maintain a copy of each employee's current, valid driver's license in their personnel file.
- Operating MK owned or leased vehicles while under the influence of alcohol or drugs is prohibited.

General Operating Requirements

- No person shall be permitted to ride with arms or legs outside of the truck body, in a standing position on the body, or on running boards or seated on side fenders, cabs, cab shields, rear of truck bed, or on the load.
- Drivers shall be responsible for the safety of all passengers and the stability of materials being hauled.
- No vehicle shall be driven at a speed greater than the posted speed limit, or than is reasonable and proper with due regard for weather, traffic, intersections, width and character of the roadway, type of motor vehicles, and any other existing condition.
- Personnel shall not mount or dismount moving vehicles.
- Personnel shall not ride in the bed of any vehicle.
- Vehicles shall not be left unattended while running.

- The operator shall not leave the key in the vehicle if it is left unattended for any length of time.

Safety and Other Equipment

- Vehicles used to transport employees shall have seats firmly secured and adequate for the number of employees to be carried.
- The use of seat belts by all personnel shall be mandatory when operating or riding in vehicles.
- Cracked or broken glass shall be replaced as soon as practical.
- All vehicles shall have a service brake system, an emergency brake system, and a parking brake system which shall be maintained in good condition at all times, including brake lights.

Vehicle Inspections

- All vehicles shall be subject to an inspection upon arrival at the site and prior to being placed into service.
- All vehicles shall be inspected by the Sample Lead weekly.
- The results of the weekly inspection shall be documented on MK forms contained in Appendix F, or equivalent, by the individual performing the inspection.
- Equipment found to be unsafe or having deficiencies that affect the safe operation of the equipment observed shall be removed from service until the equipment has been repaired. These requirements also apply to equipment such as lights, reflectors, windshield wipers, defrosters, fire extinguishers, etc.
- All tire servicing, including inflation, shall be done in compliance with 29 CFR 1910.177 and 29 CFR 1926.600.

4.2.10 Material Handling/Back Injury Prevention

- All personnel handling heavy or awkward material shall receive instruction on, and shall use, safe lifting procedures. Attendance at training courses shall be recorded and maintained by the FS or designee.
- All personnel lifting or lowering material shall be instructed to keep their knees bent, back straight, and to use their arms and legs for lifting, not their backs.
- Additional personnel and/or equipment shall be made available to provide assistance with heavy or awkward material.
- When using hand augers or impact augers for the collection of surface soil samples, the twisting and/or repetitive motion can lead to a back injury. Personnel shall exercise caution when using the augers. Personnel should refrain from over extending their natural reach/motion.
- Field personnel will not move heavy objects located on private properties under any circumstances
- Personnel involved in the dust sampling will have to lift and carry the vacuum sampler to and within homes. Personnel shall exercise caution and maintain awareness of tripping hazards that could be encountered inside the property.

4.2.11 Site Housekeeping

- All material, scrap, tools and toolboxes, and other equipment shall be stored in a neat and orderly fashion.
- Trash and scrap shall be removed from the work area on a regular basis (i.e., at least daily, before the end of each work shift) and shall never be allowed to accumulate, especially in walkways, under stairs, at the bases and landings of stairs and ladders, and near flammable substances.
- Tools, material, extension cords, hoses, or debris shall not be strewn about in a manner which may cause tripping or other hazard.
- All materials shall be maintained in safe, neat stockpiles for ease of access and to prevent collapse or falling.
- All materials brought on to the property shall be removed after the sampling event and the area left undisturbed as much as possible.

MK will strictly enforce housekeeping, inspecting work areas daily for adequate housekeeping.

4.2.12 Site Laboratory

A small laboratory area will be created in the site trailer where soil and dust samples will be dried, sieving the sample prior to analysis, and then analyzed in an x-ray fluorescent spectrometer.

Drying

Samples will be placed into an oven with a drying temperature of approximately 100°C. Personnel removing the samples from the oven after drying may be burned by contact with hot sample trays. To minimize the potential for burns, personnel shall wear safety glasses and jersey-type gloves when opening the oven door and when handling sample trays.

Sample Sieving

After samples are removed from the oven, the sample will be placed into a shaker and mechanically sieved. A sample aliquot will then be placed into a small container. Personnel may be exposed to moderate concentrations of airborne dust generated by this procedure. Personnel may also get contaminated sample material on their hands. To minimize these potential hazards, personnel shall conduct these procedures only in a fume hood either ducted to the outside of the trailer or equipped with a high efficiency particulate air (HEPA) filter. In addition, personnel shall wear disposable vinyl or nitrile gloves when handling the sample material.

Sample Analysis

Sample containers will then be placed into an XRF Spectrometer and the sample analyzed for arsenic and lead concentrations. Personnel may be exposed to high levels of x-rays (e.g., ionizing radiation) and electrical hazards. To minimize these potential hazards, personnel shall be thoroughly trained in the safe operation of the instrument by either the manufacturer or supplier. A copy of the instrument's operation manual shall be kept in the site trailer at all times. In addition, a copy of the part of the operating manual dealing with safety is located in Appendix _ of this document. Personnel shall inspect the instrument daily prior to operation in accordance with the operating manual. Under no circumstances are personnel to bypass safety switches, electrical interlocks, or other systems designed to prevent unsafe operation of the instrument.

Replacing Pre-Filters and HEPA Filters

If a laboratory bench with downdraft dust collection is used, a filter replacement schedule shall be developed to maximize the collection efficiency of the system. Replacing the filters could potentially expose personnel to elevated concentrations of airborne arsenic and lead. To minimize this potential, personnel shall disconnect the fume hood's power supply and wheel the system to the door. The fume hood shall be taken out on the steps leading into the site trailer and the door shall be closed. The fume hood shall be oriented so that personnel are standing upwind of the unit. The filter(s) shall then be replaced. Care shall be taken to minimize dust generation during filter replacement. The unit shall then be moved back to its location in the site trailer. In addition, personnel shall wear gloves while removing/replacing filters.

Equipment Decontamination

Sample preparation and analytical shall be decontaminated using soap and/or water. Personnel shall wear gloves during this work effort.

Personal Hygiene

Proper use of good personal hygiene practices is essential to minimize ingestion of contaminated soil. Personnel shall wash their hands and faces before eating, drinking, smoking, or chewing gum or tobacco.

Housekeeping

Good housekeeping practices are also essential in order to minimize potential exposure to contaminants of concern. Personnel shall immediately clean up spilled samples and place materials in designated waste containers. The area shall be immediately cleaned using wet wipe techniques or with a vacuum cleaner equipped with HEPA filters. The laboratory area shall also be cleaned each day using wet wipe techniques or with a vacuum cleaner equipped with HEPA filters.

4.3 Biological Hazards

4.3.1 Snakes

Concern for snakes in the area includes the potential presence of bull snakes. Bull snakes will be commonly found in areas with the potential for mouse populations.

4.3.2 Spiders

Species of spiders of concern in this area are the black widow and the brown recluse (fiddle-back). These spiders can be found in any location in the area, especially around the foundations of buildings and debris piles.

4.3.3 Tick-borne Diseases

The primary tick-borne diseases in this area are Rocky Mountain Spotted Fever and Lyme Disease. Ticks may be found in trees and near water.

4.3.4 Flea-borne Diseases

There have been no reputed problems identified in this area regarding flea-borne diseases.

4.3.5 Dog/Cat Bites

Rabies and potential infection is a concern from dog/cat bites. Expect the presence of pets in property yards until their absence is confirmed. Also, there is the possibility of encountering stray dogs and cats in the area. Personnel should refrain from coming in contact with domestic animals.

4.3.6 Rodents

The rodent population can be of concern especially with the onset of summer. Rodents can be found in areas of construction debris, material piles (wood, rocks, bricks, pipes) and abandoned cars/metal scrap. Even though there are no recorded cases of Hanta Virus in this area, the virus is carried when encountering and disturbing dry rodent feces and urine.

4.3.7 Wild Animals

Even though the work area is inside an urban setting, personnel should maintain an awareness for the presence of wild animals including rabbits, skunks, coyotes, foxes, and bats. Rabies is the main problem with these animals who are more likely to attack in areas near dens that contain their young.

4.4 Severe Weather

- Meteorological conditions will be watched closely, especially in the spring and summer when severe thunderstorms and tornadoes are likely to occur.
- Thunderstorms and tornadoes often occur late in the afternoon on hot spring days, but can occur at any time of the day in any season of the year.
- Tornadoes are usually preceded by severe thunderstorms with frequent lightning, heavy rain, and strong winds.
- All work on-site shall cease immediately during a thunderstorm, severe thunderstorm warning, or tornado warning in the local area (i.e., Denver County).

- A tornado warning, e.g., loud siren, will be initiated by local authorities signifying that a tornado has been sighted or detected by radar and may be approaching.
- Personnel shall take the following steps in the event of a tornado warning or sighting:
 - Evacuate office trailers or vehicles.
 - If outdoors, lie flat in a nearby ditch or low area.
 - Stay away from power poles, glass windows, electrical appliances, and metal objects.
 - Do NOT attempt to outrun a tornado.

5.0 Accident Prevention

5.1 Safety Hazards

The following safety hazards have been identified for the Vasquez Boulevard/Interstate 70 Remedial Investigation Project.

- Heat Stress
- Cold Stress
- Tools and Equipment
- Electrical Hazards
- Underground Utilities
- Fire
- Motor Vehicles
- Lifting Heavy/Awkward Material
- Housekeeping
- Slips/Trips/Falls
- Biological Hazards

Procedures to minimize these hazards to project personnel are discussed in Section 4 of this document and in the MK Accident Prevention Manual.

5.2 Personnel Responsibilities

5.2.1 Site Manager (SM)

The SM is ultimately responsible for all performance aspects of the project, including safety and health. The SM has the authority to delegate responsibility for execution of the technical aspects of the safety and health program to qualified staff representatives. The SM also has the responsibility to initiate disciplinary action for individuals that fail to comply with project procedures, including unsafe acts or practices.

5.2.2 Field Supervisor (FS)

The FS is responsible for the performance of the subcontractor construction activities assigned to them, including the assurance that the work is performed in compliance with the SSHP, and all applicable occupational safety and health regulations. The FS has the authority to enforce disciplinary actions for individuals, including subcontractors under their direction, that fail to comply with project procedures, including unsafe acts or practices.

5.2.3 Project Health & Safety Manager (HSM)

The Project Health & Safety Manager is responsible for providing guidance and technical support during the development of the SSHP. This individual is responsible for SSHP approval, oversight, and determining management compliance with the SSHP and all applicable occupational safety and health rules and regulations.

5.2.4 Site Health and Safety Officer (SHSO)

The SHSO is responsible for providing local technical guidance necessary to the effective implementation of the SSHP. The SHSO is responsible for verifying MK and subcontractor compliance with the SSHP and all applicable occupational safety and health rules and regulations. The SHSO is also responsible for performing the air sampling and monitoring described in Section 9.0, and ensuring that the training requirements described in Section 6.0 are performed and documented. The SHSO is assigned the responsibility and authority as Emergency Response Coordinator. The SHSO may delegate any of these responsibilities to safety technicians.

5.2.5 Employees

All employees are responsible for performing the tasks assigned to them in accordance with the SSHP and all applicable occupational safety and health rules and regulations. All employees are responsible for notifying their immediate supervisor, FS or SHSO of any unsafe practice or condition.

5.3 Safety Meetings

Safety meetings shall be conducted as discussed in Section 6.

5.4 First Aid and Medical Facilities

A 16 unit first aid kit, at a minimum, will be provided to each work crew and also in the site trailer. The location of the first aid kits shall be communicated to project personnel as part of the site-specific training. The phone numbers and locations of emergency contacts and medical facilities shall be posted in the site trailer and at other conspicuous locations, as necessary. The locations and phone numbers of emergency contacts for each facility are listed in Section 14.0.

5.5 Sanitation

5.5.1 Portable Toilet Facilities

Portable toilet facilities will be provided at the site trailer in accordance with OSHA 29 CFR 1926.51(c). Portable toilet facilities will be maintained in a hygienic state at all times and will be serviced at a frequency determined by the number of personnel using the facilities, but will not be serviced any less frequently than one time per week.

5.5.2 Potable Water

- Potable water shall be provided to each work crew in accordance with OSHA 29 CFR 1926.51(a). Potable water also be available at the site trailer.
- Single-use cup dispensers shall be provided adjacent to all non-dedicated potable water dispensers.
- Water shall not be dipped from containers.
- Water dispensers shall be clearly identified as drinking water.
- Water dispensers shall be cleaned regularly according to an MK-approved, pre-established schedule.
- Drink stations shall be installed only in locations approved by MK.
- Rest areas shall be kept clean, and trash shall be removed from them daily.
- Trash receptacles shall be stationed in all eating areas and emptied regularly.

5.6 Accident Reporting

- All employees and subcontractors shall report any job related injury or illness to the FS or the SHSO as soon as possible following an incident that results in injury or illness, regardless of severity.
- The MK FS and/or SHSO shall investigate and report all accidents on the MK Accident Reporting Form (Appendix H), as required in Sections 8 and 9 of the *MK Safety Procedures and Guidelines Manual*.
- The MK FS or SHSO shall notify project management (PM, SM, and HSM) immediately of any accident/incident that results in injury or illness requiring more than general first aid or property damage. The HSM or SHSO will immediately notify the MK Director of Safety and Environmental Services of any accident that results in a fatality or hospitalization of 3 or more employees.
- The FS and/or SHSO shall maintain the OSHA 200 log for recordable injuries or illnesses that occur to MK employees.
- The FS and/or SHSO shall maintain a First Aid Log for injuries or illnesses that require medical treatment, including those involving subcontractor personnel.

5.7 Daily Safety Inspections

The FS and/or SHSO or their designees shall perform daily safety inspections of the work site. The SHSO shall prepare a weekly safety inspection report that includes a description of the work activities that may affect safety and health, safety and health deficiencies and discrepancies observed, if any.

5.8 Activity Hazard Analyses

Activity Hazard Analyses for project activities are contained in Appendix I.

6.0 Health and Safety Training

6.1 Hazardous Waste Operations and Emergency Response Initial Training

Prior to initiation of work all MK and subcontractor employees shall have completed the initial 40-hour Hazardous Waste Operations Health and Emergency Response Training. All employees shall receive three days of supervised field experience by their immediate supervisor, FS, SHSO or designated crew leader. The three day training shall be documented and maintained on-site.

6.2 Hazardous Waste Operations and Emergency Response Annual Refresher Training

All MK and subcontractor employees shall receive eight hours of refresher training annually, as required in 29 CFR 1926.95(e)(8).

6.3 Hazardous Waste Operations and Emergency Response Supervisor/Manager Training

All on-site MK supervisors shall receive an additional eight hours of specialized training pursuant to 29 CFR 1926.95(e)(4). Documentation of this training shall be maintained on site.

6.4 Site-Specific Training

All MK and subcontractor field staff shall receive site-specific training prior to entering the site or commencement of work. This training will cover, but not necessarily be limited to, the following topics:

- Organizational authority and responsibilities
- Site history and summary of work activities
- Names of site health and safety personnel
- Safety, health, and other hazards present on the site
- PPE requirements
- Safe work practices
- Engineering controls
- Medical surveillance requirements, including recognition or symptoms and signs which might indicate overexposure to hazards
- Decontamination procedures
- Site control measures
- Emergency procedures

Each field personnel shall read and sign a Plan Acceptance Form before being permitted to work on the project.

Visiting subcontractor personnel and other site visitors shall receive site-specific training to the detail as determined by the SHSO prior to entering a work zone.

6.5 Tailgate Safety Meeting

- A tailgate safety meeting for all MK and subcontractor site employees shall be performed daily.
- This training shall be conducted jointly by the MK FS.

- The Daily Tailgate Safety Meeting Form, Appendix J, will be used to document this training including: date, time, personnel in attendance, topics, and instructors.

6.6 Monthly Safety Meeting

- A safety meeting for MK FS, SM, PM, SHSO, and HSM shall be performed at least once per month.
- This training shall be documented and date, time, personnel in attendance, topics, and instructor using the Monthly Supervisor Safety Meeting Form, Appendix J.

6.7 Hazard Communication

- All personnel will complete hazard communication training pursuant to 29 CFR 1910.1200 or 29 CFR 1926.59 regarding all potentially hazardous chemicals to which they might be exposed.
- This training shall be conducted jointly by the MK SHSO or his/her designee, and subcontractor Site Safety Representative and/or superintendent/supervisor.
- Refer to Section 12.0 of the MK Industrial Hygiene Procedures Manual.

6.8 CPR/First Aid

The FS, at a minimum, shall be certified in basic first aid and CPR by the American Red Cross or equivalent organization.

6.9 Substance-Specific Training

Substance-specific training for arsenic and lead, pursuant to 29 CFR 1926.1118(o) and 29 CFR 1926.62(l) will be performed for the field personnel.

6.10 Task-Specific Training

Task-specific training will be conducted for personnel involved in the following work-tasks, as applicable:

- Tool use
- Back injury prevention, proper lifting procedure
- Fire extinguishers - general principles and use

Training requirements are summarized in Table 6-1.

6.11 Training Record Maintenance

- The MK SHSO will maintain training records for all MK and subcontractor personnel.
- The subcontractor will ensure that it provides appropriate training records to the SHSO upon assignment of personnel to the project or as soon as possible following training.
- Personnel without appropriate written training certification will NOT be permitted to work on-site until the certification is received by the FS or SHSO.

**Table 6-1
Training Requirements**

Task	Area	40 Hour HAZ	8 Hour Refreshe r (as required)	8 Hour Supv	SSHP	Daily	Monthly	Arsenic and Lead- Specific	HazCom	CPR/Fi rst Aid
Mobiliza tion	All	N	N	N	Y	Y	N	N	Y	Y
Soil Samplin g	All	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dust Samplin g	All	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sample Preparati on and Analysis	All	Y	Y	Y	Y	Y	Y	Y	Y	Y
Project De- mobiliza tion	All	N	N	N	Y	Y	N	N	Y	Y

7.0 Site-specific Medical Surveillance

All project personnel who work in the Remedial Investigation will participate in a medical surveillance program as described in this section.

The medical surveillance program consists of a baseline or initial examination, an annual medical examination, a termination examination, and episodic medical examinations as necessary. At a minimum, the content of the initial, annual and termination examinations shall consist of the following medical tests and procedures (or as determined by the examining physician based on the anticipated contaminants of exposure):

- Medical and occupation history to include smoking history
- Complete physical examination
- Pulmonary function test
- Complete blood count
- Audiometry
- Complete urinalysis
- SMAC-22 biochemical profile
- Resting electrocardiogram (physician's discretion)
- Vision screen
- Chest X-ray (PA) (at the discretion of the examining physician)

The following additional tests will be administered per the OSHA Arsenic Standard, 29 CFR 1926.1118 (e.g., baseline, semi-annual, annual, termination):

- Sputum Cytology
- Urine Arsenic

An episodic examination will be required if any worker develops signs or symptoms related to the possible overexposure to hazardous substances or other health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation. The scope of any episodic examination will be left to the discretion of the examining physician.

The subcontractor will provide the MK Health & Safety Manager with a copy of each employee's completed examining physician's written opinion about the employee's ability to perform work on a hazardous waste site and to use respiratory protection, and a statement that the physician has informed the employee of the results of the exam. Both the MK SHSO and the subcontractor will maintain these records in their respective project office or on site.

The examining physician will be provided with the following information:

- Information on the employee's anticipated or measured exposure levels
- PPE used or to be used
- A description of the employee's duties as they relate to the employee's exposures
- A copy of 29 CFR 1910.120

8.0 Personal Protective Equipment (PPE)

8.1 General

In addition to engineering controls and work practices, PPE shall be used to protect personnel from exposure to contaminants which may be encountered during activities on site. MK will provide Level D PPE (with the exception of footwear) to protect the health and safety of MK project personnel, subcontractors and visitors. If respirators are needed:

- Respirators and other PPE necessary to protect the health and safety of subcontractor project personnel will be provided by the subcontractor.
- Only NIOSH/MSHA-approved respirators and cartridges will be used.
- The respirator user's medical status will be reviewed before work is performed.
- Written standard operating procedures governing the use of respirators at the site will be provided.
- Respirators will be assigned to individual employees for their exclusive use and appropriately marked to indicate to whom it was assigned for the duration of this scope of work.

8.2 Work Zone

Level D PPE will be the minimum required for all employees in the work zone and during site work.

Level D protection consists of:

- Long pants and shirt
- Steel-toed leather boots
- Safety glasses with side shields
- Leather gloves
- Disposable latex, vinyl, or nitrile gloves whenever there is a potential for contact with soil or dust

Level C protection consists of:

- Air purifying respirator, full face, with HEPA cartridges
- Hard hat
- Tyvek disposable coveralls
- Gloves (outer): disposable rubber, neoprene or nitrile
- Gloves (inner): disposable latex, vinyl, or nitrile
- Steel-toed leather boots with rubber booties or PVC, neoprene, or nitrile rubber boots with ANSI steel toe

9.0 Monitoring/Sampling

This section describes the air monitoring and air sampling programs performed to evaluate worker exposure to potentially hazardous airborne materials and perimeter air sampling and monitoring to evaluate off-site impacts. The air sampling/monitoring results will be used to:

- Assess worker exposure to potentially hazardous materials with respect to the Permissible Exposure Limit (PEL) for Air Contaminants (Title 29 Code of Federal Regulations, Part 1910.1000) or other published exposure levels.
- Assess the adequacy of engineering controls and respiratory protection.
- Delineate areas where controls or respiratory protection are needed.

9.1 Air Monitoring

A direct-reading real-time instrument capable of detecting airborne dust (e.g., MIE Miniram) will be used daily during the dust sampling subtask and in the site trailer in and around the laboratory. Readings will be taken at locations that reflect approximate concentrations of airborne dust in the breathing zone of project personnel. Results of the airborne dust monitoring will be documented. If necessary, the level of PPE used by project personnel will be modified. Section 8.0 describes the level of PPE to be used based on action levels specified in Table 9-1. The direct-reading equipment will be "response checked" according to the manufacturer's instructions prior to use each day, and calibrated yearly by the manufacturer or other qualified personnel. Records of the response check, maintenance and annual calibration will be maintained on site.

9.2 Personal Air Sampling

All air sampling will be performed in accordance with the MK Industrial Hygiene Procedures Manual. The MK Industrial Hygiene Procedures Manual describes the procedures for collecting, handling, and documenting personal air samples.

9.2.1 Arsenic

During the first full week of work, one personal time-integrated air sample will be collected daily in each house the dust sampling crew works using a personal air sampling pump. One sample will be collected each day for the first full week of work for the sample analyst.

Additional sampling for arsenic following the first week will be at the discretion of the HSM, in consultation with the SHSO. Air samples will be collected and analyzed for inorganic arsenic in accordance with NIOSH Method 7300, or equivalent method, Appendix K. Air sampling pumps will be calibrated before and after sample collection. Analysis of all air samples will be performed by an AIHA-accredited laboratory.

The SHSO will post air sampling results within five (5) days of receiving the laboratory copy of the results. Results will also be provided to the subcontractor for their records and dissemination to individual employees, in accordance with 29 CFR 1926.33 and 1910.1020.

9.2.2 Lead

During the first full week of work, one personal time-integrated air sample will be collected daily in each house the dust sampling crew works using a personal air sampling pump. One sample will be collected each day for the first full week of work for the sample analyst.

Additional sampling for lead will be at the discretion of the SHSO, in consultation with the HSM. Air samples will be collected and analyzed for inorganic lead in accordance with NIOSH Method 7300, Appendix K, or equivalent method. The air sampling pump will be calibrated before and after sample collection. Analysis of all air samples will be performed by an AIHA-accredited laboratory.

Air sampling results will be posted within five (5) days of receiving the laboratory report. Results will also be provided to the subcontractor for their records and dissemination to individual employees, in accordance with 29 CFR 1926.33 and 1910.1020.

9.3 Heat Stress Monitoring

When temperatures at the site are consistently expected to exceed 80°F, the wet bulb globe temperature (WBGT) shall be monitored to assess the potential for heat stress.

Work/rest periods will be adjusted in general accordance with the guidelines stated in the current edition of *Threshold Limit Values for Chemical Substances and Physical Agents* published by the American Conference of Governmental Industrial Hygienists.

In addition, employees shall monitor their pulse rates at the start of each rest period. If the pulse rate exceeds 110 beats per minute, the next work period shall be shortened by one-third without shortening the rest period. The pulse rate shall be monitored again at the beginning of the next rest period and if the pulse rate exceeds 110 beats per minute, the work period shall again be shortened by one third. No employee shall be permitted to continue working if his or her pulse rate exceeds 110 beats per minute continuously.

Pulse rates may be confirmed with aural temperature readings. Employees shall use the "buddy system" to monitor each other's aural temperatures at the start of each rest period. If the aural temperature exceeds 99.6°F, the next work period shall be shortened by one third without shortening the rest period. Aural temperatures shall be monitored again at the beginning of the next rest period and if the aural temperature exceeds 99°F, the work period shall again be shortened by one-third. No employee shall be permitted to continue working if his or her aural temperature exceeds 100.6°F.

Adequate quantities of cool drinking water shall be made available to employees during warm weather, as discussed in Section 4.2.2 of this SSHP.

TABLE 9-1**Air Monitoring Response Criteria**

AIRBORNE DUST CONCENTRATION (as measured with a Miniram personal dust monitor)	MONITORING FREQUENCY	ACTION TAKEN
Airborne dust concentration less than 0.45 mg/m ³ in breathing zone.	At least once every hour, when a change in operations occurs, and when requested by workers involved in operations.	<ul style="list-style-type: none">• Level D• Continue real-time air monitoring
Airborne dust concentration greater than 0.45 mg/m ³ in breathing zone.	At least once every hour, when a change in operations occurs, and when requested by workers involved in operations.	<ul style="list-style-type: none">• Stop work• Evaluate work techniques and dust suppression techniques• Continue real-time monitoring
Airborne arsenic concentration less than 0.005 mg/m ³ in breathing zone.	As discussed in Section 9.2.1	<ul style="list-style-type: none">• Level D
Airborne arsenic concentration greater than 0.005 mg/m ³ in breathing zone.	As discussed in Section 9.2.1	<ul style="list-style-type: none">• Stop work• Evaluate work techniques and dust suppression techniques
Airborne lead concentration less than 0.03 mg/m ³ in breathing zone.	As discussed in Section 9.2.2	<ul style="list-style-type: none">• Level D
Airborne lead concentration greater than 0.03 mg/m ³ in breathing zone.	As discussed in Section 9.2.2	<ul style="list-style-type: none">• Stop work• Evaluate work techniques and dust suppression techniques

10.0 Safety and Health Work Practices

Operations shall be conducted in a safe manner consistent with the policies and procedures outlined in this SSHP. The number of personnel shall be restricted to the minimum necessary to complete the required work as an administrative control to limit personnel exposures to site chemical hazards.

All project and subcontractor personnel assigned to this project are responsible for following this SSHP, for using safe practices, and for wearing the PPE specified by the SHSO. Project personnel shall report hazards and unsafe conditions and practices to the SHSO. All federal, state, and local occupational health and safety regulations must be complied with by project personnel. Violations of project procedures may include disciplinary measures up to and including termination.

10.1 Operations Safety

Policies, procedures, requirements, and specific rules shall be established to ensure the safety of workers during on-site operations.

10.1.1 General Safety Rules/Procedures

- Horseplay is not permitted during any part of the workday and will not be tolerated
- Have multi-purpose dry chemical fire extinguisher and shovel available at every site.
- Avoid driving over dry grass that is higher than the ground clearance of the vehicle. Catalytic converters on the undercarriage of vehicles are sufficiently hot to ignite dry prairie grass. Never allow a vehicle with a warm undercarriage to sit in a stationary location over dry grass or other combustible materials.
- Do not eat, drink, smoke, take medications, chew gum or tobacco, or put objects in your mouth while in the work zone or handling samples.
- When on site or handling samples, thoroughly wash hands and, if necessary, face, before eating or putting anything in your mouth (i.e., avoid hand-to-mouth contamination).
- At a minimum, wear gloves, safety glasses and steel-toed boots when inside the work zone.
- Remain aware of your own and other's positions with regard to backing up the vehicles and be especially careful when assembling, lifting and carrying items that may cause pinch-point injuries and collisions.
- Be alert to the symptoms of fatigue and heat stress and their effect on the normal caution and judgment of personnel.
- Be alert to potentially changing exposure conditions as evidenced by perceptible odors, unusual appearance of soils, oily sheen on water, or other evidence of possible contamination.
- Keep tools and equipment off the ground whenever possible to avoid tripping hazards and the spread of contamination.
- Use the buddy system at all times while operating in the site.
- Use the buddy system for all manual lifting.
- Cease all work operations on the site at sunset unless the entire control zone is adequately illuminated with artificial lighting.

- Attend the pre-job safety meeting prior to the start of the work. All team personnel are required to attend.
- Avoid direct contact with contaminated materials unless necessary for sample collection or required observation. PPE shall be worn at all times, as required.
- Do not handle contaminated soil, waste samples or any other potentially-contaminated items unless wearing appropriate gloves.
- Always use an appropriate level of personal protection as assigned in the site-specific procedures. Lesser levels of protection can result in otherwise preventable exposure. Excessive levels of safety equipment can impair efficiency and increase the potential for accidents.
- Establish pre-arranged hand signals or other means of emergency communication when wearing respiratory equipment, since this equipment seriously impairs speech communication.
- Wear hearing protection if you have to shout to communicate at a distance of three feet in steady-state (continuous) noise or when you expect loud impact noise from certain activities. Hearing protection is available and should be included in your field kit.

10.1.2 Work Site Practices

No worker may engage in any activity for which the health and safety consequences of his/her actions are unclear (e.g., previously unplanned work) without the approval of the FS and/or SHSO. If such activities become necessary to complete any phase of the work, a project instruction or procedure shall be developed and followed.

11.0 Site Control Measures

11.1 Site Work Area

Where a potential for worker exposure to potentially hazardous substances or safety or health hazards exists the flow of personnel and equipment will be controlled and minimized. Although during the Remedial Investigation the Exclusion Zones will be difficult to delineate and justify, personnel should ensure their immediate work area is free of any hazards and obstructions. Special consideration should be given to spectators, home owners and children by asking them to keep a safe distance from the operations. This will ensure that personnel are properly protected against hazards present in the work area, that work activities and contamination are confined to the appropriate areas, and that personnel can be located and evacuated in an emergency.

11.1.1 Contamination Reduction Practices in the Work Area

After the collection of soil samples, all sampling tools shall be cleaned with detergent and water provided for that purpose. Personnel should also visually inspect their clothing and remove all visible dirt and dust. This will primarily reduce the possibility of the office area or another work area becoming contaminated or affected by work activities. No personnel or equipment will be allowed to exit a work area unless contamination reduction practices have been undertaken except in emergency situations. See Section 12.0

11.1.2 Office Area

The office area will become the support area for all personnel assigned to the project. The support area will serve as the staging area for all activities to be conducted.

11.1.3 Site Work Area Controls

The following requirements will apply to all personnel entering the work area:

- The use of the "buddy system" is mandatory. No one will be allowed to work alone in the work area.
- No smoking, eating, drinking, chewing tobacco or gum, or application of cosmetics within the work area.

12.0 Personnel and Equipment Decontamination Procedures

All personnel, clothing, and equipment leaving the work area (contaminated or potentially contaminated area) shall be inspected and, if necessary, decontaminated to remove any potentially harmful substances that may have adhered to them (See 11.1.1). Some equipment/clothing may be disposed of rather than decontaminated. This section gives guidelines regarding the decontamination procedures to be implemented. Details will be described during the site-specific health and safety briefing prior to commencing field operations.

12.1 Personnel Decontamination

Decontamination will be done in the work area and will consist of the following, as appropriate:

- Boot cleaning station: Manual scraping of visible contamination from soles and side of boots.
- Personnel clothing should be inspected and any visible contamination removed.
- If hands came in contact with the soil or potentially affected items, they are to be cleaned with disposable wash towels, e.g., Wash 'N Wipes. All used wash towels shall be placed into plastic bags and disposed of as solid wastes.

12.2 Equipment Decontamination

All equipment/tools used in the work area will be decontaminated prior to removal from the site. A receptacle or bucket drop and soap and water will be used for equipment cleaning.

13.0 Logs, Reports and Recordkeeping

13.1 Health and Safety Logbook

The FS or SHSO or designees, shall maintain a Project Safety and Health Logbook for the duration of work activities at the site. The logbook will contain the following information recorded on a daily basis:

- General weather conditions (approximate wind speed and direction, temperature, precipitation, and amount of sun)
- Level of protection and any special consideration
- Any problems or unusual situations during the day
- Activities conducted throughout the day
- FS's or SHSO's signature and date

Additional records to be kept include calibration data, modifications to established safety and health procedures, and daily safety inspections. Visitors will be registered prior to entering the site. Records of training and site orientations and briefings will be kept with the project files.

13.2 Reports

A weekly site safety and health inspection report shall be prepared by the FS or SHSO or designees. This report shall identify work activities, safety and health-related deficiencies, and corrective measures. All incidents that result in property damage, personnel injuries or illness will be investigated and notification/reporting requirements met per standard MK policy and procedure.

13.3 Additional Records

13.3.1 Personnel Records

Personnel records to be maintained by the FS include:

- Hazwoper training certificates: 40-hour, 8-hour annual refresher, 8-hour supervisor
- First Aid/CPR
- Signed Plan Acceptance Form
- Examining Physician's Written Opinion
- Task-specific training records: back injury prevention, etc.

13.3.2 Air Monitoring Instruments

Air monitoring instrument records to be maintained by the FS and/or SHSO include:

- Instrument serial numbers
- Annual manufacturer calibration records
- Daily site calibration records
- Instrument manufacturer operation manuals

13.4 Recordkeeping

The FS and/or SHSO shall maintain records of all injuries and illnesses of MK and subcontractor employees incidental to the work in accordance with 29 CFR 1904, including copies of the Worker's Compensation First Report of Injury. The SHSO shall determine whether or not each injury is OSHA recordable per the guidance provided in Recordkeeping Guidelines for Occupational Injuries and Illnesses. These records will be maintained on the OSHA 200 log or equivalent. A record of all first aid treatments not otherwise recordable shall be maintained and furnished to the USEPA

upon request. The SHSO shall maintain records of employee exposure to potentially harmful toxic materials, harmful physical agents and medical records, in accordance with 29 CFR 1910.120.

14.0 Emergency Response Plan and Contingency Procedures

This section describes the emergency response plan contingency procedures to be implemented in the event of injuries, illnesses, accidents, and fires. The contingency plan provides guidelines for the proper response to emergency situations, but the actual response will be situation dependent.

In the event of an emergency, the FS or SHSO or designee will order all personnel to take appropriate action which could include any or all of the following:

- Evacuate the work zone to a safe place of refuge.
- Notify emergency services as identified in Table 14-1.
- Identify the nature and location of the emergency.

14.1 Pre-Emergency Planning

In addition to the guidance provided in this document, task-specific safety meetings will include emergency response preplanning specific to each task and work site. This training will include:

- **Assembly Points.** If the work activity may result in a release of hazardous substances, more than one assembly point will be specified to ensure that at least one up-wind assembly point is accessible.
- **Emergency Response Coordinator.** The FS or SHSO or designee, as the on-site emergency response coordinator, will contact the emergency response providers, account for individuals at the assembly point, and plan the appropriate response.
- **Evacuation Routes.** Routes will be specified as needed.
- **Means of Evacuation.** The number of personnel that may be evacuated from the work site by various routes will be evaluated.
- **Means of Communication.** This will include the means of alerting personnel to an emergency at all points in the work site and should consider the sound-screening potential of hearing protection, distance and noisy equipment when specifying the use of alarms, horns and sirens. The means of communication with emergency response providers will be considered.
- **Designation of a location for first-aid services.**
- **Procedures to be followed by employees who remain to operate critical operations.**

Emergency response providers (ambulance, fire, police) will be appraised of their responsibilities under this SSHP, and provided with such advance information as necessary to enable them to respond to an emergency expeditiously, while minimizing risk to themselves.

14.2 Responsibilities

The following is a description of personnel roles, lines of authority, and the emergency response communication/notification responsibilities for site personnel.

14.2.1 Site Personnel

It is the responsibility of all site personnel to recognize conditions that have the potential for resulting in a personal injury or damage to property, and to report the condition immediately.

14.2.2 Site Manager

The SM or designee is responsible for assuring adherence to the administrative elements and implementation of the Emergency Response Plan, as referenced in this document. He/she will evaluate the site's preparedness for emergency responses and identify special conditions which may require additional preparations. He/she will ensure that necessary equipment and facilities are provided to support this plan.

14.2.3 Project Health and Safety Manager

The H SM or designee is responsible for coordinating response actions to emergency situations. He will coordinate with project management to ensure the availability of response equipment and supplies, and initiate drills. Emergency response plans will be evaluated over the course of the project by the SHSO to keep them up-to-date and to ensure that they are applicable and relevant to emergency response organizations.

14.3 Emergency Recognition and Prevention

Site personnel shall be apprised of hazards and life-threatening emergency situations during site-specific training. Means to control hazards and mitigate emergency situations will be addressed at that time.

14.4 Safety Zones

Suitable assembly points will be established at the start of the project by the FS and/or SSHO to provide a safe point of refuge for site personnel. Additional information will be provided in the site briefing concerning other hazards that may arise at the site.

14.5 Site Security and Control

At all times, site personnel shall be apprised of any emergency and only authorized personnel shall be allowed into the area. As necessary, areas may be cordoned off and access restricted. Local law enforcement officials may be called upon to assist in crowd control and escort emergency services personnel to the scene.

14.6 Evacuation Routes

Evacuation routes shall be posted in various locations on the site. All site personnel will be made aware of evacuation procedures during site-specific training.

14.7 Emergency Decontamination

In the event an employee is injured or becomes ill and requires hospital treatment, the extent of decontamination to be performed will be assessed based on severity of the injury or illness and time delay that decontamination may cause. If the employee has any signs of contamination, the ambulance and hospital staff will be notified of this and the nature of the contamination. Reasonable effort will be expended to decontaminate the victim prior to removal from the site.

14.8 First Aid and Medical Treatment

All site personnel shall be instructed in the location of first aid supplies and trained personnel authorized to administer first aid. At least one person holding a valid certificate in first aid and CPR training from the American Red Cross (or equivalent) shall be on site at all times. Table 14-1 lists the organizations to contact in the event of various emergencies. This list will be completed with phone numbers and posted in prominent locations for MK and subcontractor personnel to use.

14.9 Communications

Field staff shall be equipped with radios or mobile phones for communications on-site.

14.10 PPE and Emergency Equipment

Any actions by site personnel pursuant to either a rescue or spill response must be conducted with an understanding of the potential hazards involved and performed while wearing the appropriate personal protective equipment. Portable fire extinguishers will be used for fire protection in all vehicles, work and storage areas, and the site trailer.

14.11 Response Assessment

All responses to emergency situations shall be investigated by the SHSO. The SHSO shall document the conditions and response to the emergency. This critique shall be maintained in project files, and revisions to this section shall be made as appropriate.

**Table 14-10672
Personnel Names and Emergency Telephone Numbers**

MK Personnel Names and Telephone Numbers		
Contact	Title	Telephone Number(s)
Steve Sterling	Program Manager	(O) (303) 948-4690 (H) (303) 220-0672
Marta Valentine	Site Manager	(O) (303) 948-4693 (H) (303) 904-9026
Craig Beck	Health & Safety Manager	(O) (303) 948-4691 (H) (303) 693-1228
David Franco	Site Health & Safety Officer	(O) (303) 948-4657 (H) (303) 806-8818
Local Emergency Telephone Numbers		
Fire Department	Denver	911
Police Department	Denver	911
Ambulance Services	Denver	911
Hospital	Presbyterian/St. Luke's Medical Center 1719 E. 19 th Avenue	303-839-6000
U.S. Environmental Protection Agency Contacts		
Bonnie Lavelle	Remedial Project Manager	(O) (303) 312-6579

Directions to the Closest Hospital from the Site Trailer:

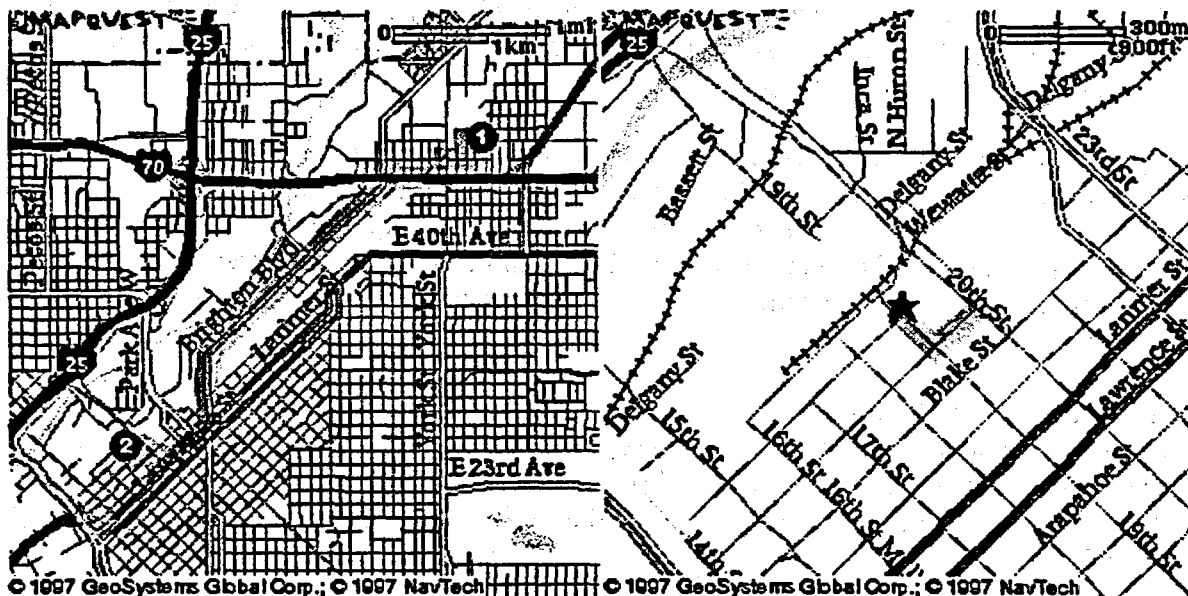
1. Start out going WEST on E. 48th AVENUE towards ELIZABETH STREET
2. Turn LEFT onto COLUMBINE STREET
3. Turn RIGHT onto E. 47th AVENUE
4. Turn LEFT onto YORK STREET
5. Take the I-70 WEST ramp
6. Merge onto I-70 WEST
7. Take the CO-265/BRIGHTON BLVD exit
8. Keep LEFT at the fork in the ramp
9. Turn LEFT onto BRIGHTON BLVD
10. BRIGHTON BLVD becomes BROADWAY
11. Turn SLIGHTLY RIGHT onto LARIMER STREET
12. Turn RIGHT onto 20th STREET
13. Turn LEFT onto WAZEE STREET
14. Turn RIGHT onto 19th STREET

See Figure 14-1 for a map from the site to the hospital.

Figure 14-1
Direction from Site Trailer to Presbyterian/St. Luke's Medical Center
1719 E. 19th Avenue

Starting From:	Arriving At:	Distance:	Approximate Travel Time:
2645 E. 48th Street	1719 E. 19th Street	3.7 miles	11 mins
Denver, CO 80216	Denver, CO 80202		

- | | Directions | miles |
|-----|--|--------------|
| 1. | Start out going West on E 48TH AVE towards ELIZABETH ST. | 0.1 |
| 2. | Turn LEFT onto COLUMBINE ST. | 0.1 |
| 3. | Turn RIGHT onto E 47TH AVE. | 0.1 |
| 4. | Turn LEFT onto YORK ST. | 0.1 |
| 5. | Take the I-70 WEST ramp. | 0.2 |
| 6. | Merge onto I-70 W. | 0.1 |
| 7. | Take the CO-265/BRIGHTON BLVD exit | 0.1 |
| 8. | Keep LEFT at the fork in the ramp. | 0.0 |
| 9. | Turn LEFT onto BRIGHTON BLVD. | 1.7 |
| 10. | BRIGHTON BLVD becomes BROADWAY. | 0.4 |
| 11. | Turn SLIGHT RIGHT onto LARIMER ST. | 0.4 |
| 12. | Turn RIGHT onto 20TH ST. | 0.2 |
| 13. | Turn LEFT onto WAZEE ST. | 0.1 |
| 14. | Turn RIGHT onto 19TH ST. | 0.1 |



15.0 Spill Containment Plan

Spills and releases are unlikely to occur due to the handling procedures to be used. However, since accidents and uncontrolled releases may happen, the following information will be used by project personnel to respond to and mitigate any releases on the site.

15.1 Preplanning for Spill Control

Work activities will be reviewed for release potential and the capability of on-site personnel to respond adequately. All aspects of the Emergency Response Plan as described in Section 14.0, will be reviewed by site personnel to ensure adequacy and that resources are available.

MK will coordinate emergency preparedness and response with the USEPA, subcontractors, and state and local personnel to ensure a coordinated effort in planning for a spill emergency. Spill response plans will be compatible and integrated.

15.2 Spill and Fire Control Materials and Equipment

When moving or handling of drums containing hazardous materials, ensure that salvage drums or containers, meeting U.S. Department of Transportation specifications, and suitable quantities of proper absorbent materials, neutralizing agents, and fire suppression equipment are kept available in areas where spills, leaks or ruptures may occur.

Drums and containers will be inspected for defects and their integrity assured prior to being filled with any non-solid hazardous substance.

Liquid hazardous material spills can be contained with porous or absorbent barriers. Absorbent materials can take several configurations (pillows, sheets, brooms, loose chips, particle beads, and fibers) that may be set in place, or scattered by hand or blower. Preferred sorbents are inert nonreactive clay minerals (neutralizing agents may be added), or specific formulations which provide automatic neutralization or vapor control.

15.3 Drum, Container and Tank Handling and Moving Procedures

Drums, containers, and tanks of hazardous or flammable substances will not be moved until preparations described in the SSHP are completed (i.e., all required equipment and materials are at the work site ready for use, and the employees have been familiarized with their responsibilities, the emergency response procedures, and the potential hazards associated with the contents of the drums and containers).

Work site operations will be organized to minimize the amount of drum or container movement. Each drum or containers will be inspected before it is moved to ensure that it can be picked up without a rupture or puncture, and relocated without a spill or leak. Unlabeled drums and containers will be treated as hazardous substances and handled accordingly until the contents are positively identified and labeled.

Drums and containers under pressure, as evidenced by bulging or swelling, will not be moved until the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosion.

Equipment used to handle the drums and containers will be selected, positioned, operated, and maintained to minimize rupture, puncture, dent, or drop. Likewise, equipment will be selected, positioned and operated to minimize the potential for equipment ignition sources to ignite vapors released from ruptured drums or containers.

Drums and containers that cannot be moved without rupture, leakage or spillage will be emptied into a sound container using a device specific for the material being transferred.

16.0 Substance Abuse Program

16.1 MK Employees

All MK employees are subject to the policies and procedures described in the MK Corporation Substance Abuse Prevention/EAP (SAPP/EAP) Programs.

16.2 Subcontractors

All subcontractors shall certify that each subcontractor employee assigned to the Vasquez Boulevard/Interstate 70 Remedial Investigation Project has tested negative for the following drug classifications; marijuana, cocaine, opiates, PCP, and amphetamines within one week of beginning site work at the project. This certification shall be provided before to MK prior to the subcontractor employee begins site work.

All subcontractors shall certify that Workplace Drug testing must be done through a current NIDA certified laboratory.

16.2.1 Random Drug Testing Frequency

Employees may be tested periodically, at the discretion of the SHSO, FS or Site Manager.

16.2.2 Drug Testing Audits

The Project Health and Safety Manager CIH or his/her designee will conduct periodic audits on the subcontractor's Drug Testing and Compliance Program.

16.3 Post-Accident/Incident Testing

All accidents that result in occupational injury requiring medical treatment or following an accident/incident that results in property damage in which safety rules were violated shall require the affected personnel to submit to drug screening. Section IX of the Morrison Knudsen Corporation SAPP/EAP describes the procedure for Post-Accident/Incident Testing.

APPENDIX A

SAFETY VIOLATION NOTICE (FORM CAS-21)



COMPANY _____

SAFETY VIOLATION NOTICE

To: _____

Date: _____

From: _____

A Safety and Health Survey of your operations has revealed non-compliance of certain contract specifications, Morrison Knudsen Corporation safety and health policies and/or local, State or Federal regulations. As a condition of the contract, and applicable regulations, you are required to maintain a safe work environment and to prevent unsafe actions of your employees.

The Violations(s) noted and the required Corrective Action(s) is/are indicated below:

Reference

Descriptions of Violation

1.

2.

3.

4.

Corrective Action Required:

Violation(s) No.

- | | |
|-------|---|
| _____ | <input type="checkbox"/> Cease operation until corrective action is complete. |
| _____ | <input type="checkbox"/> Initiate and complete corrective action by _____ |
| _____ | <input type="checkbox"/> Warn employees and instruct them on proper procedures. |
| _____ | <input type="checkbox"/> Take appropriate disciplinary action. |
| _____ | <input type="checkbox"/> Provide proper equipment. |
| _____ | <input type="checkbox"/> Change procedure/work methods. |

Complete the following and return to the Project's safety representative:

Action(s) Taken:

1.

2.

3.

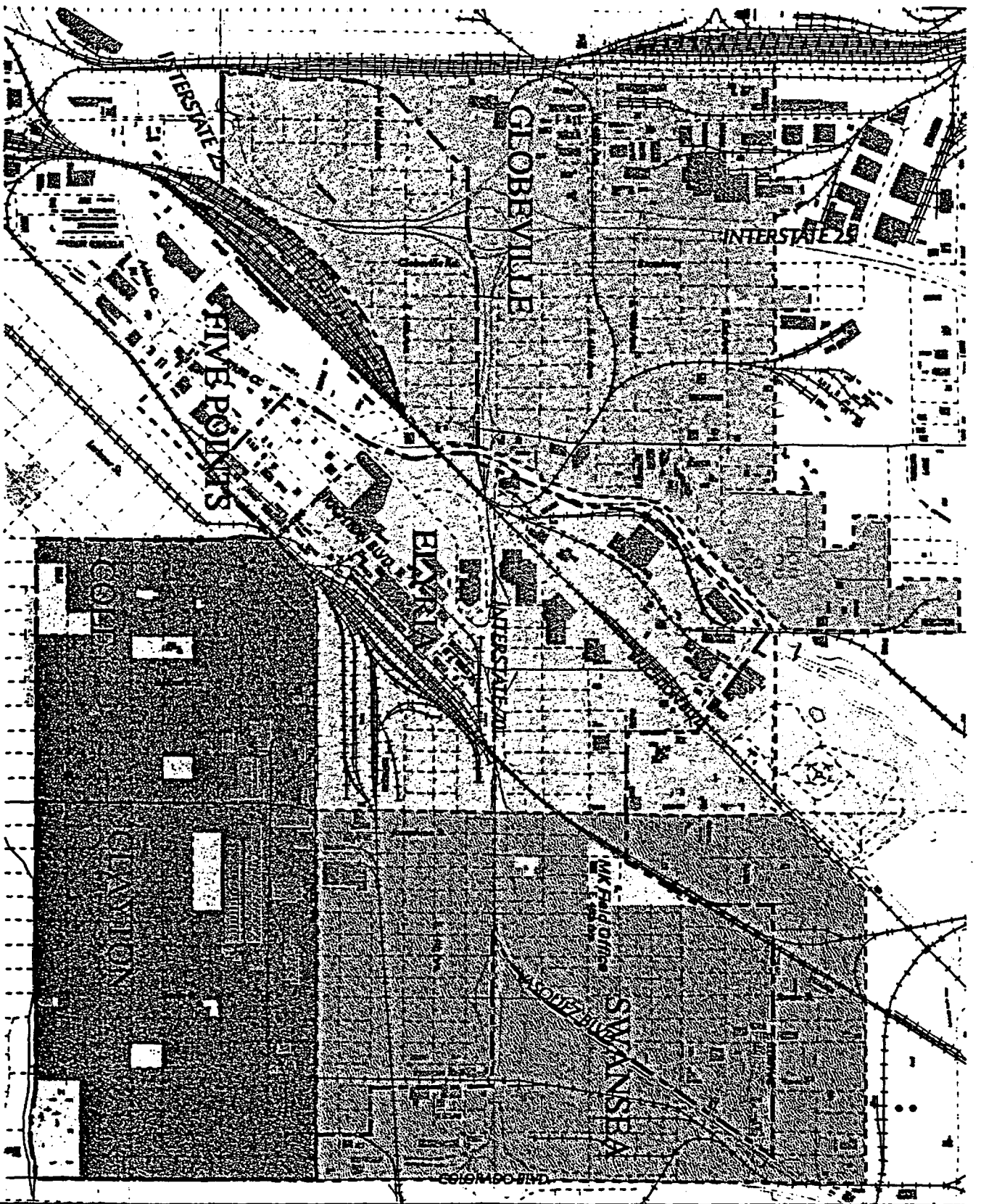
4.

Date: _____

Signature/Position

APPENDIX B

SITE MAP



SITE MAP

VASQUEZ BLVD-70

APPENDIX C
MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard,
29 CFR 1910.1200. Standard must be
consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072



IDENTITY (As Used on Label and List)

ALCONOX

Note: Blank spaces are not permitted. If any item is not applicable, or no
information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name

ALCONOX, INC.

Emergency Telephone Number

CHEMTEL: 800-255-3924

Address (Number, Street, City, State, and ZIP Code)

9 EAST 40th STREET
NEW YORK, NY 10016

Telephone Number for Information

212-532-4040

Date Prepared

FEBRUARY 18, 1993

Signature of Preparer (person)

Section II -- Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))

OSHA PEL

ACGIH TLV

Other Limits
Recommended

100 (1000000)

THERE ARE NO INGREDIENTS IN ALCONOX WHICH APPEARED ON THE
OSHA STANDARD 29 CFR 1910 SUBPART Z.

Section III -- Physical/Chemical Characteristics

Boiling Point

N.A.

Specific Gravity (H₂O = 1)

N.A.

Vapor Pressure (mm Hg.)

N.A.

Melting Point

N.A.

Vapor Density (AIR = 1)

N.A.

Evaporation Rate
(Butyl Acetate = 1)

N.A.

Solubility in Water

APPRECIABLE (GREATER THAN 10 PER CENT)

Appearance and Odor

WHITE POWDER INTERSPERSED WITH CREAM-COLORED FLAKES - ODORLESS

Section IV -- Fire and Explosion Hazard Data

Flash Point (Method Used)

NONE

Flammable Limits

LEL

N.A.

UEL

N.A.

Extinguishing Media

WATER, CO₂, DRY CHEMICAL, FOAM, SAND/EARTH

Special Fire Fighting Procedures

FOR FIRES INVOLVING THIS MATERIAL DO NOT ENTER WITHOUT

PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS

Unusual Fire and Explosion Hazards

NONE

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid	NONE
	Stable	XX		

Incompatibility (Materials to Avoid)

AVOID STRONG ACIDS

Hazardous Decomposition or Byproducts

MAY RELEASE CO. GAS ON BURNING

Hazardous Polymerization	May Occur		Conditions to Avoid	NONE
	Will Not Occur	XX		

Section VI — Health Hazard Data

Route(s) of Entry:	Inhalation?	YES	Skin?	NO	Ingestion?	YES
--------------------	-------------	-----	-------	----	------------	-----

Health Hazards (Acute and Chronic)

INHALATION OF POWDER MAY PROVE LOCALLY IRRITATING TO
MUCOUS MEMBRANES. INGESTION MAY CAUSE DISCOMFORT
AND/OR DIARRHEA.

Carcinogenicity:	NTP?	NO	IARC Monographs?	NO	OSHA Regulated?	NO
------------------	------	----	------------------	----	-----------------	----

Signs and Symptoms of Exposure

EXPOSURE MAY IRRITATE MUCOUS MEMBRANES.
MAY CAUSE SNEEZING.

Medical Conditions

Generally Aggravated by Exposure

RESPIRATORY CONDITIONS MAY BE AGGRAVATED BY POWDER

Emergency and First Aid Procedures

EYES-FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SKIN-FLUSH WITH PLENTY OF WATER.
INGESTION-DRINK LARGE QUANTITIES OF WATER. GET MEDICAL ATTENTION FOR DISCOMFORT.

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled

MATERIAL FOAMS PROFUSELY. SHOVEL AND RECOVER
AS MUCH AS POSSIBLE. RINSE REMAINDER TO SEWER.
MATERIAL IS COMPLETELY BIODEGRADABLE.

Waste Disposal Method

SMALL QUANTITIES MAY BE DISPOSED OF IN SEWER. LARGE QUANTITIES SHOULD
BE DISPOSED OF ACCORDING TO LOCAL REQUIREMENTS FOR NON-HAZARDOUS DETERGENT.

Precautions to Be Taken in Handling and Storing

STORE IN A DRY AREA TO PREVENT CAKING.

Other Precautions

NO SPECIAL REQUIREMENTS OTHER THAN THE GOOD INDUSTRIAL HYGIENE
AND SAFETY PRACTICES EMPLOYED WITH ANY INDUSTRIAL CHEMICAL.

Section VIII — Control Measures

Respiratory Protection (Specify Type)

DUST MASK

Ventilation	Local Exhaust	NORMAL	Special	N.A.
	Mechanical (General)	N.A.	Other	N.A.

Protective Gloves

USEFUL-NOT REQUIRED

Eye Protection

USEFUL-NOT REQUIRED

Other Protective Clothing or Equipment

NOT REQUIRED

Work/Hygiene Practices

NO SPECIAL PRACTICES REQUIRED

APPENDIX D
HEAT STRESS MANAGEMENT

HEAT STRESS MANAGEMENT

HEAT STRESS MONITORING

For strenuous field activities that are part of ongoing site work activities in hot weather, the following procedures shall be used to monitor the body's physiological response to heat, and to monitor the work cycle of each site worker. There are two phases to this monitoring: initial work/rest cycle determination and physiological monitoring. The initial work/rest cycle is used to estimate how long the first work shifts of the day should be. Heart rate monitoring of each worker will establish the length of the successive work periods.

DETERMINATION OF THE INITIAL WORK/REST CYCLES

Measure the air temperature with a standard thermometer which is shielded from the sun. Estimate the fraction of sunshine by judging what percent the sun is out to determine the sunshine quality factor: 100% sunshine - no cloud cover = 1.0; 50 % sunshine and 50% cloud cover = 0.5; 0% sunshine = full cloud cover = 0.0.

Plug these variable into the following equation to determine the adjusted temperature:

$$T (^{\circ}\text{F}, \text{adjusted}) = T (^{\circ}\text{F}, \text{actual}) + (13 \times \text{sunshine quality factor})$$

Use the chart below to determine the length of the first work shift. At the first break, initiate the heart rate monitoring as described in the next section.

ADJUSTED TEMPERATURE	NORMAL WORK CLOTHES	CHEMICAL PROTECTIVE CLOTHING
$\geq 32.2^{\circ}\text{C}$	After each 45 minutes of work	After each 15 minutes of work
30.8° to 32.2°C	After each 60 minutes of work	After each 30 minutes of work
28.1° to 30.8°C	After each 90 minutes of work	After each 60 minutes of work
25.3° to 28.1°C	After each 120 minutes of work	After each 90 minutes of work
22.5° to 25.3°C	After each 150 minutes of work	After each 120 minutes of work

HEART RATE MONITORING

Heart rate should be measured by radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. The HR should be measured again three minutes later and should not exceed 80 beats/minute. If both heart rate criteria are met, the subsequent work period may remain the same. If either HR criteria is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same.

AURAL TEMPERATURE READINGS

An aural thermometer can be used to determine core body temperature. At the end of the work period, insert the thermometer into the ear canal in accordance with the manufacturer's instructions. The aural temperature at the beginning of the rest period should not exceed 99.6°F. The aural temperature should be measured again three minutes later and should not exceed 99.6°F. If both aural temperature criteria are met, the subsequent work period may remain the same. If either aural temperature criteria is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the aural temperature still exceeds 99.6°F at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same.

Do not permit workers to wear semipermeable or impermeable garments if her/his aural temperature exceeds 100.6°F.

HEAT STRESS PREVENTION

The best approach is preventive heat stress management. In general:

- Have workers drink at least 16 oz of water before beginning work;
- Provide disposable 8 oz cups and water or electrolyte replacement fluids, e.g., Gatorade, that is maintained at 50 to 60°F; a minimum of 1 quart/hour/person should be maintained onsite;

- Urge workers to drink one to two cups of water every 20 minutes or at each rest break for a total of four to eight quarts per day;
- Provide a cool, preferably air-conditioned area for rest breaks;
- Discourage the drinking of alcohol at night and discourage the intake of coffee, tea or other beverages containing caffeine during working hours;
- Monitor for signs of heat stress; and
- Acclimate workers to site work conditions by slowly increasing workloads, i.e., do not begin working at 100% working site work activities with extremely demanding activities.

HEAT STRESS MANAGEMENT

HEAT STRESS MONITORING

For strenuous field activities that are part of ongoing site work activities in hot weather, the following procedures shall be used to monitor the body's physiological response to heat, and to monitor the work cycle of each site worker. There are two phases to this monitoring: initial work/rest cycle determination and physiological monitoring. The initial work/rest cycle is used to estimate how long the first work shifts of the day should be. Heart rate monitoring of each worker will establish the length of the successive work periods.

DETERMINATION OF THE INITIAL WORK/REST CYCLES

Measure the air temperature with a standard thermometer which is shielded from the sun. Estimate the fraction of sunshine by judging what percent the sun is out to determine the sunshine quality factor: 100% sunshine - no cloud cover = 1.0; 50 % sunshine and 50% cloud cover = 0.5; 0% sunshine = full cloud cover = 0.0.

Plug these variable into the following equation to determine the adjusted temperature:

$$T (^{\circ}\text{F, adjusted}) = T (^{\circ}\text{F, actual}) + (13 \times \text{sunshine quality factor})$$

Use the chart below to determine the length of the first work shift. At the first break, initiate the heart rate monitoring as described in the next section.

ADJUSTED TEMPERATURE	NORMAL WORK CLOTHES	CHEMICAL PROTECTIVE CLOTHING
$\geq 32.2^{\circ}\text{C}$	After each 45 minutes of work	After each 15 minutes of work
30.8° to 32.2°C	After each 60 minutes of work	After each 30 minutes of work
28.1° to 30.8°C	After each 90 minutes of work	After each 60 minutes of work
25.3° to 28.1°C	After each 120 minutes of work	After each 90 minutes of work
22.5° to 25.3°C	After each 150 minutes of work	After each 120 minutes of work

HEART RATE MONITORING

Heart rate should be measured by radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. The HR should be measured again three minutes later and should not exceed 80 beats/minute. If both heart rate criteria are met, the subsequent work period may remain the same. If either HR criteria is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same.

AURAL TEMPERATURE READINGS

An aural thermometer can be used to determine core body temperature. At the end of the work period, insert the thermometer into the ear canal in accordance with the manufacturer's instructions. The aural temperature at the beginning of the rest period should not exceed 99.6°F. The aural temperature should be measured again three minutes later and should not exceed 99.6°F. If both aural temperature criteria are met, the subsequent work period may remain the same. If either aural temperature criteria is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the aural temperature still exceeds 99.6°F at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same.

Do not permit workers to wear semipermeable or impermeable garments if her/his aural temperature exceeds 100.6°F.

HEAT STRESS PREVENTION

The best approach is preventive heat stress management. In general:

- Have workers drink at least 16 oz of water before beginning work;
- Provide disposable 8 oz cups and water or electrolyte replacement fluids, e.g., Gatorade, that is maintained at 50 to 60°F; a minimum of 1 quart/hour/person should be maintained onsite;
- Urge workers to drink one to two cups of water every 20 minutes or at each rest break for a total of four to eight quarts per day;
- Provide a cool, preferably air-conditioned area for rest breaks;

- Discourage the drinking of alcohol at night and discourage the intake of coffee, tea or other beverages containing caffeine during working hours;
- Monitor for signs of heat stress; and
- Acclimate workers to site work conditions by slowly increasing workloads, i.e., do not begin working at 100% working site work activities with extremely demanding activities.

APPENDIX E

COLD STRESS MANAGEMENT

COLD STRESS

In cold environments, the body's metabolic rate must increase to maintain its thermal balance. Shivering increases the metabolic heat production and yet the feet, face, and hands still may feel cold. This often creates confusion for the exposed individual because he/she may be warmly clothed. Portions of the body become overheated while the extremities remain cold. The regulation of blood flow and sweating cannot uniformly keep all parts of the body in thermal balance.

Human performance in extreme cold depends ultimately on the maintenance of the physiological thermal balance. (Important physiological changes that occur are the maintenance of higher skin temperatures and blood flow to the face and hands. This sacrifice of body heat preserves these areas from frostbite.)—From a practical standpoint, -30°F is probably the lower limit for efficient, prolonged outdoor work. At -60°F many kinds of outdoor activity become exceedingly difficult.

WIND-CHILL FACTOR

Wind-chill temperature is a better description of thermal conditions than the ambient temperature alone in cold environments; the wind adds to the rate of cooling. At a wind-chill temperature of -25°F exposed flesh may freeze within one minute. However, fingers, toes, ears, nose tips, or cheeks may become frostbitten at ambient temperatures as high as 28°F with high winds.

HYPOTHERMIA

Lowering of body temperature can occur from exposure to conditions well above freezing. The lethal deep body temperature is about 78°F . This can occur when a worker (such as a diver) is immersed in cold water; is exposed to cool, high winds; is in a state of physical exhaustion; or has insufficient food. Alcohol should not be consumed in cold environments because the resultant dilation of blood vessels can permit a rapid loss of body heat increasing the risk of hypothermia. For warming purposes, liquid intake should be hot, nonalcoholic beverages or soup.

FROSTBITE

There are two types of frostbite: superficial (involving only the skin), and deep (extending below the skin). Unless frostbite is superficial (short exposure time), assume the injury to be deep and get the patient to the hospital as quickly as possible. If any part of the body is frozen, it should be protected from further cold injury, but no attempts should be made to thaw it in the field.

Superficial frostbite can be treated by:

- o Covering the cheeks with warm hands until pain returns
- o Placing uncovered frostbitten fingers under the opposing armpit next to the skin
- o Placing bare frostbitten feet under the clothing against the skin of a companion.

Never rewarm a frostbitten part by massage, cold water soaks, rubbing with snow, or exposure to open fire. Gradual rewarming against the skin is the preferred method. It is important to remember that pain will occur when skin thaws. Medical authorities should be notified.

PROTECTIVE CLOTHING

Loose clothing worn in layers provides maximum protection; the trapped layers of warm air insulate more effectively than the cloth itself. However, when working in a cold environment, moisture evaporated from the skin during work condenses in passing through the clothes and freezes in the outer layers. The insulation of the wet clothes may be insufficient to keep a person warm when activity stops. Therefore, clothing must be kept dry, and a means of evaporating perspiration should be provided by opening the neck, waist, arm sleeves, and ankle fasteners as needed to allow periodic fresh air circulation. If clothing cannot be kept dry, personnel should periodically leave the cold environment to warm themselves and dry their clothing. Further soaking of clothing can be avoided by shaking or brushing snow off them before entering heated shelters.

Because the skin on the hands can freeze easily, cold metal should never be touched with bare hands.

When the nature of the work permits, a waterproof hat and a loose, long, water-repellent but vapor-permeable coat should be worn over other garments to keep them dry while still permitting enough air movement to evaporate perspiration. Conventional pants should be tucked in and lapped over boot tops to prevent snow and cold water from entering the boot. Foot wear for outdoor work in wet snow should be waterproof and reach well up on the leg. The soles and upper part of the boot should provide good insulation.

Face protection, such as a wool scarf or cold-weather mask, should be worn during severe wind-chill conditions. It is vital that face protectors be removed periodically to check for frostbite.

FOOD AND LIQUID INTAKE

Balanced meals and adequate liquid intake are vital to body heat production and the prevention of dehydration. Dehydration is as common in cold regions as it is in hot, dry areas. Warm liquids (hot soup or tea) are preferable because they do not have to be warmed by the body after consumption. Cold foods and drinks should only be eaten when absolutely necessary.

ADOPTED THRESHOLD LIMIT VALUES***COLD STRESS**

These Threshold Limit Values (TLVs) are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body core temperature from falling below 36°C and to prevent cold injury to body extremities. Deep body temperature is the core temperature of the body as determined by rectal temperature measurements. For a single, occasional exposure to a cold environment a drop in core temperature to no lower than 35°C should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head for cold injury.

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low-temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 2-K-1. Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air or to immersion in cold water at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating clothing to maintain core temperatures above 36°C must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill factor^a or the cooling power of the air is a critical factor. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required. An equivalent chill temperature chart relating the actual dry bulb air

* 1986-1987 Adoption.

^a Wind chill factor is a unit of heat loss from a body defined in watts per meter squared per hour being a function of the air temperature and wind velocity upon the exposed body.

Table 2-K-1
Progressive Clinical Presentations of Hypothermia*

Core Temperature		Clinical Signs
°C	°F	
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32	89.6	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
29	84.2	
28	82.4	Ventricular fibrillation possible with myocardia irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular fibrillation
21	69.8	
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

* Presentations approximately related to core temperature. Reprinted from the January 1982 issue of *American Family Physician*, published by the American Academy of Family Physicians.

temperature and the wind velocity is presented in Table 2-K-2. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

EVALUATION AND CONTROL

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -32°C (-25°F). Superficial or deep local tissue freezing will occur only at temperatures below -1°C regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 2-K-3.

Table 2-K-2

Wind Chill Factor Chart*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Table 2-K-3

Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
1. -26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4
2. -29° to -31°	-20° to -24°	(Norm. Breaks)	1	75min	2	55 min	3	40 min	4	30 min	5
3. -32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
4. -35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
5. -38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease					
6. -40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease							
7. -43° & below	-45° & below	Non-emergency work should cease									

Notes for Table 2-K-3:

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:
5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill of about 1750 W/m²; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m². In general the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

* Adopted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 16°C (60°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars shall be covered by thermal insulating material at temperatures below -1°C (30°F).
2. If the air temperature falls below 16°C (60°F) for sedentary, 4°C (40°F) for light, or -7°C (20°F) for moderate work and fine manual dexterity is not required, then gloves shall be used by the workers.

To prevent contact frostbite, the workers should wear anticontact gloves.

1. When cold surfaces below -7°C (20°F) are within reach, a warning should be given to each worker by his/her supervisor to prevent inadvertent contact by bare skin.
2. If the air temperature is -17.5°C (0°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection is required if work is performed in an environment at or below 4°C (40°F). The workers shall wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the jobsite is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area, or by wearing an easily removable outer windbreak layer garment. Wind chill cooling rates are illustrated in Figure 2-K-1 and Table 2-K-4.
2. If only light work is involved and if the clothing on the worker may become wet on the jobsite, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee shall make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee shall change into dry clothes before entering the cold area. The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change shall be determined empirically and will vary individually according to the type of shoe worn and the individual's feet sweat.

3. If extremities, ears, toes, and nose cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handware, footwear, and face masks, these protective items shall be supplied in auxiliary heated versions.
4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.
5. Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 4°C (40°F) shall take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point only just above ambient temperatures.

Table 2-K-4
Wind Chill Cooling Rate Effects*

Wind Chill Rates (Watts/m ² /hr)	Comments/Effects
700	Conditions considered comfortable when dressed for skiing.
1200	Conditions no longer pleasant for outdoor activities on overcast days.
1400	Conditions no longer pleasant for outdoor activities on sunny days.
1600	Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine.
2300	Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
2700	Exposed flesh will freeze within half a minute for the average person.

* From Canadian Department of the Environment, Atmospheric Environment Service.

WORK-WARMING REGIMEN

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F) heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter the outerlayer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of a diuretic and circulatory effect.

For work practices at or below -12°C (10°F) ECT the following shall apply:

1. The worker shall be under constant protective observation (Buddy System or supervision).
2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.
3. New employees shall not be required to work full-time in cold in the first days until they become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker.
5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers shall be instructed in safety and health procedures. The training program shall include as a minimum instruction in:
 - a. Proper rewarming procedures and appropriate first aid treatment.
 - b. Proper clothing practices.
 - c. Proper eating and drinking habits.

- d. Recognition of impending frostbite.
- e. Recognition signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
- f. Safe work practices.

SPECIAL WORKPLACE RECOMMENDATIONS

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.
2. Special wind protective clothing shall be provided based upon existing air velocities to which workers are exposed.

Special caution shall be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required when there is an expanse of snow coverage causing a potential eye exposure hazard.

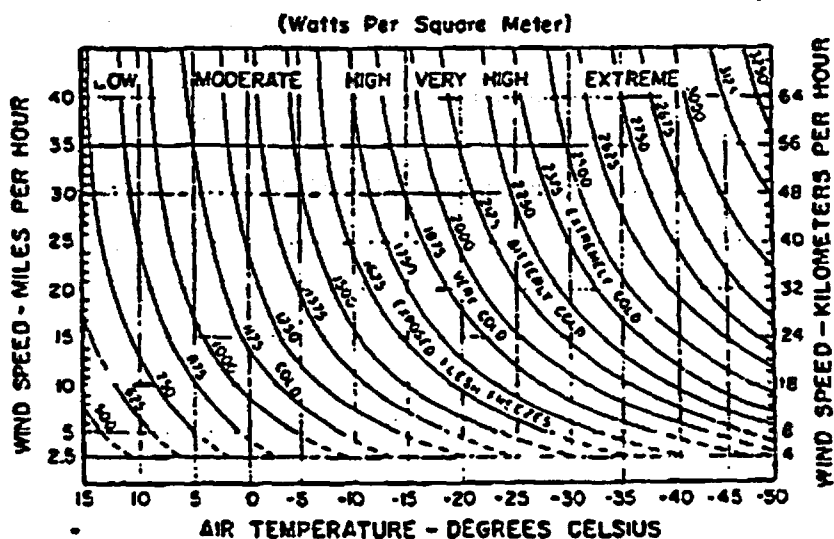
Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60°F) to enable overall compliance with the requirements of the TLV to be maintained.
2. Whenever the air temperature at a workplace falls below -1°C (30°F), the dry bulb temperature should be measured and recorded at least every 4 hours.
3. In indoor workplaces, the wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).
4. In outdoor work situations, the windspeed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30°F).
5. The equivalent chill temperature shall be obtained from Table 2-K-3 in all cases where air movement measurements are required, and shall be recorded with the other data whenever the equivalent chill temperature is below -7°C (20°F).

Employees shall be excluded from work in cold at -1°C (30°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-10°F) with wind speeds less than five miles per hour, or air temperatures below -18°C (0°F) with wind speeds above five miles per hour should be medically certified as suitable for such exposure.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment.

Figure 2-K-1



WIND CHILL COOLING RATES. Adapted from the Canadian Department of the Environment, Atmospheric Environment Service.

APPENDIX F

EQUIPMENT INSPECTION FORMS



**MORRISON
KNUDSEN
CORPORATION**

Engineering and Construction Division

AUTOMOTIVE: AUTOMOBILE AND PICKUP

Safety and Preventive Maintenance Inspection

Inspected by: _____

AK Number: _____

Hours/Miles: _____

Contract Number: _____

Date: _____

Item	Check One Only			Explain Deficiencies
	O.K.	N/A	Repair	
HORN AND MIRRORS				
LIGHTS/TURN SIGNALS				
CAB/GLASS/WIPERS				
EMERGENCY BRAKE				
SERVICE BRAKES				
CLUTCH OPERATION				
SEAT CONDITION/BELTS				
GAUGES				
RADIATOR AND HOSES				
FLUID LEVELS/CONDITION				
BELTS - WEAR AND TENSION				
SMOG SYSTEM AND HOSES				
AIR INTAKE SYSTEM				
BATTERY AND WIRING				
ENGINE OPERATION				
OIL LEAKS				
FRONT SUSPENSION				
EXHAUST SYSTEM				
REAR SUSPENSION				
TRANSMISSION LEAKS				
TRANSFER CASE LEAKS				
DIFFERENTIAL SEAL(S)				
JOINTS				
BODY CONDITION/PAINT				
WHEELS AND TIRES				
JACK AND LUG WRENCH				
LOAD TEST				

TIRE CONDITION: Average percent of wear remaining _____ %

Additional Items or Information: _____

Signature: _____

APPENDIX G

XRF SPECTROMETER SAFETY INFORMATION

XRF SAFETY INFORMATION

SEE SPECTRACE QUANX INSTRUMENT OPERATIONS MANUAL

APPENDIX H

ACCIDENT REPORTING FORMS



SUPERVISOR'S ACCIDENT INVESTIGATION REPORT

FORM CAS 2477

To be completed by employee's foreman/supervisor within 24 hours
of the accident and routed to the project or mine safety department.

Name	Age	Time of accident a.m. p.m.	Date of accident	Date Returned to Work
Job Classification	Job Assignment when Injured	Length of Service	Location of Accident (specific)	

Nature of injury and first aid treatment

Referred to Doctor/Hospital

Detailed description of accident

Primary cause of accident

Injury cause(s)

- | | | |
|--|--|---|
| <input type="checkbox"/> Failure to follow job procedure | <input type="checkbox"/> Inexperience | <input type="checkbox"/> Fall |
| <input type="checkbox"/> Inattention to job | <input type="checkbox"/> Faulty equipment | <input type="checkbox"/> Violation of safety rule |
| <input type="checkbox"/> Improper lifting | <input type="checkbox"/> Improper use of tools | <input type="checkbox"/> Flying/falling objects |
| <input type="checkbox"/> Other (describe) | | |

When was employee's foreman/supervisor informed of accident

Witnesses

Foreman's/supervisor's investigation findings and corrective action recommended and/or taken to prevent recurrence

Equipment Involved

Damage Estimate \$

Description of Damage to Equipment

Ident Investigation by: _____
Foreman/Supervisor

Date of Investigation: _____

Reviewed: _____
Safety Supervisor/Representative

Date: _____

ACCIDENT DATA REPORT

Please Type or Print Legibly

Contract No.:		Contract Location:		<input type="checkbox"/> Original Submittal <input type="checkbox"/> Correction Submittal	
Name (Last, First, M.I.):			Social Security No.:		Type of Injury: 1 Recordable 2 Medical Nonrecordable 5 Lost Time 9 Fatal 10 Non-Industrial
Accident Date:		Date Reported:		Date Returned/Work:	
Person Submitting Report:			Date:		Telephone No.:
(Circle One Injury Cause Code OR One Illness Cause Code)					

INJURY CAUSE CODES Struck by Tool or Object 01 hand tool or machine in use 02 falling or flying objects 03 tipping, sliding or rolling objects 04 object handled by others 05 moving parts of machine 07 object being lifted or handled 08 motor vehicle 80 foreign body in eye Strain or Overexertion 11 lifting 12 using tool or machine 13 pushing or pulling 14 holding or carrying 15 reaching Cut, Puncture, Scrape Injury by 17 hand tool-utensil-not powered 18 powered hand tool-appliance 19 object being lifted-handled 26 broken glass	Fall or Slip 21 on same level 22 from different level 23 slipped, but not fall Striking Against 31 object being handled 32 stepping on sharp objects 33 stationary object 34 moving parts of machine 35 sanding-scraping-cleaning oper. Motor Vehicle Injuries 37 collision with another vehicle 38 collision with a fixed object 39 vehicle upset Caught On, In, or Between 41 machine or machine parts 42 mechanical apparatus 43 object handled-other object Burn or Heat-Cold Exposure 51 steam or hot fluids 52 welding operations 53 fire or flame	Burn or Heat-Cold Exposure 54 contact with hot object 55 acids-chemicals 56 welding burns to eyes 59 extreme heat-cold exposure Miscellaneous Causes 70 contact with electrical current 81 by animal or insect 92 explosion or flashback 97 insufficient information 99 miscellaneous-describe _____ 100 equipment damage only ILLNESS CAUSE CODES Illness 61 occupational skin disease 62 respiratory condition 63 poisoning 64 dust diseases 65 disorders due to physical agents 66 repeated trauma disorders 67 other
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Description of Injury/Illness:

Foreman: (PRINT)	Superintendent/Supervisor: (PRINT)
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(Circle One from EACH Category)			
21-Worker Class 1 craft 2 foreman 3 supervisor 4 other 22-Craft 01 administration 02 boilermaker 03 carpenter 04 cement finisher 05 driller 06 electrician 07 engineer 08 iron worker 09 laborer 10 mechanic 11 millwright 12 miner 13 operating eng'r 14 painter 15 pipefitter 16 teamster 17 technician/OC/RAD 18 warehouse 19 welder 20 other	22-Craft 22 metalsmith 23 refueler 24 avionics technician 25 radio technician 24-Work Phase 01 carpentry 02 clearing 03 concrete 04 electrical 05 erection 06 excavation 07 general labor 08 mechanical 09 mining 10 nuclear 11 office 12 paving 13 pile driver 14 sheet metal 15 tunnel 16 warehouse 17 welding 18 other 19 fabrication 20 line service	24-Work Phase 21 a/c movement 22 a/c refueling 23 a/c maintenance 24 component repair 25 fuel truck repair 26 equipment install 26-Employment Period 01 1 week or less 02 2-4 weeks 03 1-2 months 04 2-6 months 05 6-12 months 06 1-2 years 07 2-5 years 08 5-10 years 09 over 10 years 10 unknown 28-Approximate Age 1 under 20 2 20-30 3 31-40 4 41-50 5 51-60 8 over 61	28-Approximate Age 7 unknown 29-Time of Accident 01 0801-1000 02 1001-1200 03 1201-1400 04 1401-1600 05 1601-1800 06 1801-2000 07 2001-2200 08 2201-2400 09 0001-0200 10 0201-0400 11 0401-0600 12 0601-0800 13 unknown 31-Injury Type 01 amputation 02 strain/sprain 03 crush/mash/smash 04 fracture 05 cut/puncture/laceration 06 burn 07 contusion/abrasions 08 foreign body/eye injury
31-Injury Type 09 none-refer to illness code 10 other 33-Body Part 01 head/face 02 eye 03 neck/shoulders 04 arm/elbow 05 wrist/hand 06 thumb/finger 07 back 08 chest/lower trunk 09 ribs 10 hip 11 leg/knee 12 foot/ankle 13 toe 14 hernia, rupture 15 heart attack 16 hearing loss 17 internal 18 death 19 multiple 20 other			

COMPLETE ALL SECTIONS

APPENDIX I

ACTIVITY HAZARD ANALYSES

Hazard Analysis

General Physical Hazards

General Physical Hazards	Potential Hazards	Control Measures
<p><u>Equipment That May be Used:</u></p> <ul style="list-style-type: none"> Gloves Safety glasses with side shields Steel-toe boots (as specified in the task plan) Long-sleeve shirts and pants <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> Daily <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> Task-specific Proper use and operation of hand tools First Aid/CPR training (American Red Cross) as required 	Slip, trip, fall	<ul style="list-style-type: none"> Site workers will be required to wear gloves, safety glasses with safety shields, work gloves, steel-toe boots, and long-sleeve shirts and pants when working in the field Whenever possible, avoid routing cords, ropes, and hoses across walking pathways, Immediately refill sampling holes to protect against falls.
	Hazards due to poor housekeeping (i.e., slip, trip, fall)	<ul style="list-style-type: none"> Work areas will be kept clean and orderly. Garbage and trash will be disposed of regularly in approved refuse containers. Tools and accessories will be properly maintained and stored. Work areas and floors will be kept free of dirt, grease, and slippery materials. Materials shall be stored to allow clear access to aisles, pathways, and travel routes. Field vehicles will be kept clean and orderly (i.e., cab, truck beds, tool boxes, trunk, camper shells).
	Back injuries from manual lifting	<ul style="list-style-type: none"> Size up the job. Think it through. Lift with your legs, not your back. Use mechanical equipment whenever possible. Get assistance when manually lifting awkwardly-sized items or those over 60 pounds.
	Minor cuts and bruises	<ul style="list-style-type: none"> Workers shall wear appropriate field attire (i.e., no tank tops, shorts, open-toe shoes, jewelry). Tools not functioning properly shall be removed from service immediately and tagged for repair. Worker shall wear cotton or leather work gloves when handling equipment. Have at least one person onsite trained in First Aid/CPR.
	Splash with contaminated liquid	<ul style="list-style-type: none"> Apply first aid. Remove contaminated clothing. Notify emergency (911). Use portable eyewash as necessary. Review cause and implement remedy before continuing work.

Hazard Analysis
Underground Hazards

Underground Hazards	Potential Hazards	Control Measures
<p><u>Equipment That May be Used</u></p> <ul style="list-style-type: none"> • Hand shovels • Hand Auger <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> • Utilities inspection <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> • Site specific 	<ul style="list-style-type: none"> • Electrocution • Explosion 	<ul style="list-style-type: none"> • Before beginning intrusive activities, the Field Supervisor shall ensure that underground utilities are located. • When underground utilities are exposed, they shall be protected to avoid damage. • All uncovered lines shall be identified before work proceeds. • Personnel may use a non-conductive hand probe to find the exact location of the lines and will use hand shovels to carefully remove the soil adjacent to the lines. • Identify work area to be cleared. • Contact owner of work area. • Will receive approval for permit or relocate activities. • Sample 3 feet from an identified underground utility line • Inspect the area for signs of new trenches, excavations, and erosion that may indicate newly laid utility lines

Hazard Analysis Energized Electrical Equipment

Energized Electrical Equipment	Potential Hazards	Control Measures
<p><u>Equipment That May be Used:</u></p> <ul style="list-style-type: none"> • Double-Insulated tools <p><u>Inspection Requirements:</u></p> <ul style="list-style-type: none"> • Prior to startup <p><u>Training Requirements:</u></p>	<p>Electrocution</p> <p>Electrical burns</p> <p>Fire</p>	<ul style="list-style-type: none"> • Maintain a minimum distance of 20 feet between electrical lines and any part of equipment. • Portable electrical tools and equipment will be double-insulated. • Workers will not handle electrical equipment or wires if their hands are wet or they are standing on wet surfaces. • Electrical cords shall be pulled from the outlet by the plug not the electrical cord. • Identify the location of electrical lines in the work area. • Power tools shall be tagged and removed from service when not functioning properly. • Lockout/tagout procedure shall be implemented when employees need to perform repair or maintenance on electrical equipment where the unexpected energization, or start-up of stored energy could cause injury. • Worn or frayed extension cords shall be replaced. • All electrical wiring and equipment shall be a type listed by Underwriters laboratories or another recognized listing agent for the specific application. • Before work begins, the Field Supervisor shall ensure by inquiry, observation, or instruments that any part of an electric power circuit will not bring any person, tool, or machine into contact with it. • Extension cords shall not be fastened with staples, hung from nails, or suspended by bare wire. • GFCIs shall be used with portable electric equipment. • Electrical extension cords shall be rated for extra hard usage.

Hazard Analysis Housekeeping

Housekeeping	Potential Hazards	Control Measures
<u>Equipment That May be Used</u> <ul style="list-style-type: none"> • Trash containers • Hand tools <u>Inspection Requirements</u> <ul style="list-style-type: none"> • Daily <u>Training Requirements</u> <ul style="list-style-type: none"> • General awareness 	Slip, trip, fall	<ul style="list-style-type: none"> • Personnel will clean-up the work site daily and dispose of trash. • Refuse containers or bins will be readily available on site. • Provide adequate storage for tools and equipment. • Provide adequate lighting in all work areas. • Provide adequate ventilation in all work areas. • Work areas and floors shall be kept clear of debris. • Materials shall not be stacked higher than 6 feet. • Provide stools, ladder where workers need to access elevated storage areas. • Protruding nails in scrap boards, planks, and lumber shall be removed, hammered in, or bent over flush with the wood. • Weeds and grass shall be kept down.. • Flammable materials shall be placed in approved flammable storage containers..

Hazard Analysis Material Handling

Materials Handling	Potential Hazards	Control Measures
Equipment That May be Used: <ul style="list-style-type: none"> Equipment dolly Forklift Inspection Requirements <ul style="list-style-type: none"> Daily Training Requirements <ul style="list-style-type: none"> Hazardous Chemicals Handling Hazardous Materials Safe lifting practices 	Back injuries	<ul style="list-style-type: none"> Size up the job. Use mechanical equipment to lift and move items when necessary. Lift with your legs, not your back. Do not lift awkwardly sized items and those over 60 pounds. Get assistance when necessary. If a worker loses control of item, STAND CLEAR and DO NOT try to prevent its fall. Do not twist or turn your back when lifting an object or turning the hand auger
	Pinch points	<ul style="list-style-type: none"> Keep hands and feet clear of moving/suspended materials and equipment. Recommend wearing steel-toe safety shoes.
	Slip, trip, fall	<ul style="list-style-type: none"> Do not stand on drums, boxes, or bags of stored materials.
	Cuts, bruises	<ul style="list-style-type: none"> Use cotton or leather work gloves for material handling.
	Splashes	<ul style="list-style-type: none"> Wear eye protection as needed (safety glasses, goggles, faceshield)
	Chemical burns	<ul style="list-style-type: none"> Wear appropriate protective clothing and chemical resistant gloves as specified.

Hazard Analysis
Exposure to Environmental Elements
Heat Stress

Heat Stress	Potential Hazards	Control Measures
Equipment That May be Used: <ul style="list-style-type: none"> • Oral thermometers • WBGT Monitor • Tympanic thermometers Inspection Requirements <ul style="list-style-type: none"> • At each break Training Requirements <ul style="list-style-type: none"> • Heat stress-Prevention, Symptoms, Treatment 	Heat rash	<ul style="list-style-type: none"> • Change perspiration-soaked clothing when necessary. • Bathe at the end of day or work shift. • Apply powder to affected areas.
	Heat cramps	<ul style="list-style-type: none"> • Drink plenty of cool fluids even when not thirsty. • Provide cool fluids to work crews. • Move victim to shaded, cool area.
	Heat exhaustion	<ul style="list-style-type: none"> • Avoid caffeinated beverages. • Physiological worker monitoring, as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate.
	Heat stroke	<ul style="list-style-type: none"> • Evaluate possibility of night work • Physiological worker monitoring, as needed (i.e., heart rate, oral temperature). • Wear body cooling devices.

Hazard Analysis
Exposure to Environmental Elements
Adverse Weather

Adverse Weather	Potential Hazards	Control Measures
<u>Equipment That May be Used:</u> <ul style="list-style-type: none"> Weather radio Shelter <u>Inspection Requirements</u> <ul style="list-style-type: none"> Throughout work activities <u>Training Requirements</u> <ul style="list-style-type: none"> First Aid/CPR (American Red Cross) as required 	Lightning strikes	<ul style="list-style-type: none"> Whenever possible, halt activities and take cover. If outdoors, stay low to the ground. Seek shelter in a building if possible. Stay away from windows. If available, crouch under a group of trees instead of one single tree. Minimize contact with the ground and keep body parts that must touch the ground as close together as possible.
	Thunderstorms, tornados	<ul style="list-style-type: none"> Listen to the radio announcements for pending weather information. Cease field activities during thunderstorm or tornado warnings as directed by field supervisor. Seek shelter. Do not try to outrun a tornado.

**Hazard Analysis
Exposure to Environmental Elements
Adverse Weather**

Adverse Weather	Potential Hazards	Control Measures
<u>Equipment That May be Used:</u> <ul style="list-style-type: none"> • Weather radio • Shelter <u>Inspection Requirements</u> <ul style="list-style-type: none"> • Throughout work activities 	Lightning strikes	<ul style="list-style-type: none"> • Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Minimize contact with the ground and keep body parts that must touch the ground as close together as possible.
<u>Training Requirements</u> <ul style="list-style-type: none"> • First Aid/CPR (American Red Cross) as required 	Thunderstorms, tornados	<ul style="list-style-type: none"> • Listen to the radio announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings as directed by field supervisor. • Seek shelter. Do not try to outrun a tornado.

Hazard Analysis Laboratory Operations

General Physical Hazards	Potential Hazards	Control Measures
Equipment That May be Used: <ul style="list-style-type: none"> • XRF • Laboratory hood • Sieve • Safety glasses with side shields • Gloves • Steel-toed boots (as specified in the task plan) Inspection Requirements <ul style="list-style-type: none"> • Daily Training Requirements <ul style="list-style-type: none"> • Task-specific • Proper use and operation of stump chipper • First Aid/CPR training (American Red Cross) as required 	Slip, trip, fall Poor housekeeping	<ul style="list-style-type: none"> • Whenever possible, avoid routing cords, ropes, and hoses across walking pathways. • Work areas will be kept clean and orderly. • Garbage and trash will be disposed of regularly in approved refuse containers. • Tools and accessories will be properly maintained and stored. • Work areas and floors will be kept free of dirt, grease, and slippery materials. • Materials shall be stored to allow clear access to aisles, pathways, and travel routes.
	Burns from the oven and drying pans	<ul style="list-style-type: none"> • Wear gloves at all times when opening ovens and handling drying pans
	Injuries due to flying debris	<ul style="list-style-type: none"> • Inspect the equipment daily prior to use. • Ensure that all equipment is in good condition • Wear safety glasses when opening ovens and operating sieve
	Minor cuts and bruises	<ul style="list-style-type: none"> • Workers shall wear appropriate field attire (i.e., no tank tops, shorts, open-toe shoes, jewelry). • Tools not functioning properly shall be removed from service immediately and tagged for repair. • Worker shall wear cotton or leather work gloves when handling equipment. • Have at least one person onsite trained in First Aid/CPR.
	Exposure to airborne arsenic and lead	<ul style="list-style-type: none"> • Conduct all potentially dusty operations in the laboratory hood • Replace laboratory hood filters outdoors while standing upwind • Inspect the laboratory hood each day to ensure proper operation
	Exposure to x-rays	<ul style="list-style-type: none"> • Inspect instrument each day before operating • Instrument to be operated only by properly trained personnel • Operate instrument in accordance with operating manual • Do not bypass safety locks, interlocks, etc. • Repairs and maintenance shall be performed only by authorized personnel

Activity Hazard Analysis
Soil & Dust Sampling of Arsenic and Lead Contaminated Material

Arsenic Contaminated Material	Potential Hazards	Control Measures
<p><u>Equipment That May Be Used:</u></p> <ul style="list-style-type: none"> • Safety glasses with side shields • Steel-toed boots (as specified in the task plan) • Leather gloves • Long-sleeved shirts and long pants <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> • Equipment: When first delivered to site, daily • Utilities: Prior to excavating <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> • 40-hour basic HAZWOPER • 8 hour HAZWOPER refresher • 8 hour HAZWOPER supervisor (for supervisory personnel) • Task-specific • Arsenic and lead specific training • First Aid/CPR training (American Red Cross) as required 	<p><u>Health Hazard:</u></p> <ol style="list-style-type: none"> 1. Ingestion of arsenic and lead contaminated material 2. Inhalation of arsenic and lead contaminated material 	<ul style="list-style-type: none"> • Site workers will be required to wear gloves, safety glasses with safety shields, long sleeve shirts and long pants, and steel-toe boots when working in the field. • Workers are required to wash/clean their hands after finishing soil sampling activities in one area and before moving to the other area. Also, prior to eating, drinking, smoking, or chewing gum/tobacco. • Real time and time-integrated air sampling to be conducted daily when excavating arsenic contaminated soils. • Dust suppression to be initiated when airborne dust levels exceed 0.45 mg/m³ • Site workers will decontaminate their clothing and boots, as needed, prior to leaving the work area. • Sampling equipment will be decontaminated prior to leaving the work area. • All employees participating in the Vasquez Boulevard Remedial Investigation will be participate in a comprehensive medical surveillance program. Sputum Cytology and Urine Arsenic samples will be collected: Prior to initially starting work in arsenic contaminated areas, semi annual, annual and upon termination.
	<p><u>Physical Hazard:</u> Transporting equipment and materials to job site</p>	<ul style="list-style-type: none"> • Use adequate blocking. • Comply with local speed limits. Utilize signalmen where necessary. • Only licensed drivers to drive vehicles • Be aware of personnel and residents when backing up or entering traffic • Perform daily equipment safety inspections.

Hazard Analysis

General Physical Hazards

General Physical Hazards	Potential Hazards	Control Measures
<p><u>Equipment That May be Used:</u></p> <ul style="list-style-type: none"> Gloves Safety glasses with side shields Steel-toe boots (as specified in the task plan) Long-sleeve shirts and pants <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> Daily <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> Task-specific Proper use and operation of hand tools First Aid/CPR training (American Red Cross) as required 	Slip, trip, fall	<ul style="list-style-type: none"> Site workers will be required to wear gloves, safety glasses with safety shields, work gloves, steel-toe boots, and long-sleeve shirts and pants when working in the field Whenever possible, avoid routing cords, ropes, and hoses across walking pathways, Immediately refill sampling holes to protect against falls.
	Hazards due to poor housekeeping (i.e., slip, trip, fall)	<ul style="list-style-type: none"> Work areas will be kept clean and orderly. Garbage and trash will be disposed of regularly in approved refuse containers. Tools and accessories will be properly maintained and stored. Work areas and floors will be kept free of dirt, grease, and slippery materials. Materials shall be stored to allow clear access to aisles, pathways, and travel routes. Field vehicles will be kept clean and orderly (i.e., cab, truck beds, tool boxes, trunk, camper shells).
	Back injuries from manual lifting	<ul style="list-style-type: none"> Size up the job. Think it through. Lift with your legs, not your back. Use mechanical equipment whenever possible. Get assistance when manually lifting awkwardly-sized items or those over 60 pounds.
	Minor cuts and bruises	<ul style="list-style-type: none"> Workers shall wear appropriate field attire (i.e., no tank tops, shorts, open-toe shoes, jewelry). Tools not functioning properly shall be removed from service immediately and tagged for repair. Worker shall wear cotton or leather work gloves when handling equipment. Have at least one person onsite trained in First Aid/CPR.
	Splash with contaminated liquid	<ul style="list-style-type: none"> Apply first aid. Remove contaminated clothing. Notify emergency (911). Use portable eyewash as necessary. Review cause and implement remedy before continuing work.

Hazard Analysis
Underground Hazards

Underground Hazards	Potential Hazards	Control Measures
<p><u>Equipment That May be Used</u></p> <ul style="list-style-type: none"> • Hand shovels • Hand Auger <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> • Utilities Inspection <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> • Site specific 	<ul style="list-style-type: none"> • Electrocution • Explosion 	<ul style="list-style-type: none"> • Before beginning intrusive activities, the Field Supervisor shall ensure that underground utilities are located. • When underground utilities are exposed, they shall be protected to avoid damage. • All uncovered lines shall be identified before work proceeds. • Personnel may use a non-conductive hand probe to find the exact location of the lines and will use hand shovels to carefully remove the soil adjacent to the lines. • Identify work area to be cleared. • Contact owner of work area. • Will receive approval for permit or relocate activities. • Sample 3 feet from an identified underground utility line • Inspect the area for signs of new trenches, excavations, and erosion that may indicate newly laid utility lines

Hazard Analysis Energized Electrical Equipment

Energized Electrical Equipment	Potential Hazards	Control Measures
<p><u>Equipment That May be Used:</u></p> <ul style="list-style-type: none"> • Double-Insulated tools <p><u>Inspection Requirements:</u></p> <ul style="list-style-type: none"> • Prior to startup <p><u>Training Requirements:</u></p>	<p>Electrocution</p> <p>Electrical burns</p> <p>Fire</p>	<ul style="list-style-type: none"> • Maintain a minimum distance of 20 feet between electrical lines and any part of equipment. • Portable electrical tools and equipment will be double-insulated. • Workers will not handle electrical equipment or wires if their hands are wet or they are standing on wet surfaces. • Electrical cords shall be pulled from the outlet by the plug not the electrical cord. • Identify the location of electrical lines in the work area. • Power tools shall be tagged and removed from service when not functioning properly. • Lockout/tagout procedure shall be implemented when employees need to perform repair or maintenance on electrical equipment where the unexpected energization, or start-up of stored energy could cause injury. • Worn or frayed extension cords shall be replaced. • All electrical wiring and equipment shall be a type listed by Underwriters laboratories or another recognized listing agent for the specific application. • Before work begins, the Field Supervisor shall ensure by inquiry, observation, or instruments that any part of an electric power circuit will not bring any person, tool, or machine into contact with it. • Extension cords shall not be fastened with staples, hung from nails, or suspended by bare wire. • GFCIs shall be used with portable electric equipment. • Electrical extension cords shall be rated for extra hard usage.

Hazard Analysis Housekeeping

Housekeeping	Potential Hazards	Control Measures
<u>Equipment That May be Used</u> <ul style="list-style-type: none"> • Trash containers • Hand tools <u>Inspection Requirements</u> <ul style="list-style-type: none"> • Daily <u>Training Requirements</u> <ul style="list-style-type: none"> • General awareness 	Slip, trip, fall	<ul style="list-style-type: none"> • Personnel will clean-up the work site daily and dispose of trash. • Refuse containers or bins will be readily available on site. • Provide adequate storage for tools and equipment. • Provide adequate lighting in all work areas. • Provide adequate ventilation in all work areas. • Work areas and floors shall be kept clear of debris. • Materials shall not be stacked higher than 6 feet. • Provide stools, ladder where workers need to access elevated storage areas. • Protruding nails in scrap boards, planks, and lumber shall be removed, hammered in, or bent over flush with the wood. • Weeds and grass shall be kept down.. • Flammable materials shall be placed in approved flammable storage containers..

Hazard Analysis

Material Handling

Materials Handling	Potential Hazards	Control Measures
<u>Equipment That May be Used:</u> <ul style="list-style-type: none"> Equipment dolly Forklift 	Back injuries	<ul style="list-style-type: none"> Size up the job. Use mechanical equipment to lift and move items when necessary. Lift with your legs, not your back. Do not lift awkwardly sized items and those over 60 pounds. Get assistance when necessary. If a worker loses control of item, STAND CLEAR and DO NOT try to prevent its fall. Do not twist or turn your back when lifting an object or turning the hand auger
<u>Inspection Requirements</u> <ul style="list-style-type: none"> Daily 		
<u>Training Requirements</u> <ul style="list-style-type: none"> Hazardous Chemicals Handling Hazardous Materials Safe lifting practices 	Pinch points	<ul style="list-style-type: none"> Keep hands and feet clear of moving/suspended materials and equipment. Recommend wearing steel-toe safety shoes.
	Slip, trip, fall	<ul style="list-style-type: none"> Do not stand on drums, boxes, or bags of stored materials.
	Cuts, bruises	<ul style="list-style-type: none"> Use cotton or leather work gloves for material handling.
	Splashes	<ul style="list-style-type: none"> Wear eye protection as needed (safety glasses, goggles, faceshield)
	Chemical burns	<ul style="list-style-type: none"> Wear appropriate protective clothing and chemical resistant gloves as specified.

Hazard Analysis
Exposure to Environmental Elements
Heat Stress

Heat Stress	Potential Hazards	Control Measures
<u>Equipment That May be Used:</u> <ul style="list-style-type: none"> • Oral thermometers • WBGT Monitor • Tympanic thermometers <u>Inspection Requirements</u> <ul style="list-style-type: none"> • At each break <u>Training Requirements</u> <ul style="list-style-type: none"> • Heat stress-Prevention, Symptoms, Treatment 	Heat rash	<ul style="list-style-type: none"> • Change perspiration-soaked clothing when necessary. • Bathe at the end of day or work shift. • Apply powder to affected areas.
	Heat cramps	<ul style="list-style-type: none"> • Drink plenty of cool fluids even when not thirsty. • Provide cool fluids to work crews. • Move victim to shaded, cool area.
	Heat exhaustion	<ul style="list-style-type: none"> • Avoid caffeinated beverages. • Physiological worker monitoring, as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate.
	Heat stroke	<ul style="list-style-type: none"> • Evaluate possibility of night work • Physiological worker monitoring, as needed (i.e., heart rate, oral temperature). • Wear body cooling devices.

Hazard Analysis
Exposure to Environmental Elements
Cold Stress

Cold Stress	Potential Hazards	Control Measures
<p><u>Equipment That May be Used</u></p> <ul style="list-style-type: none"> • Insulated clothing <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> • On each break • As conditions warrant <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> • Cold Stress - Prevention, Symptoms, Training 	<ul style="list-style-type: none"> • Frost nip • Frostbite • Hypothermia 	<ul style="list-style-type: none"> • Wear insulating clothing when temperatures drop below 40°F. • Refuse containers or bins will be readily available on site. • Provide adequate storage for tools and equipment. • Provide adequate lighting in all work areas. • Provide adequate ventilation in all work areas. • Work areas and floors shall be kept clear of debris. • Materials shall not be stacked higher than 6 feet. • Provide stools, ladder where workers need to access elevated storage areas. • Protruding nails in scrap boards, planks, and lumber shall be removed, hammered in, or bent over flush with the wood. • Weeds and grass shall be kept down.. • Flammable materials shall be placed in approved flammable storage containers..

**Hazard Analysis
Exposure to Environmental Elements
Adverse Weather**

Adverse Weather	Potential Hazards	Control Measures
<u>Equipment That May be Used:</u> <ul style="list-style-type: none"> • Weather radio • Shelter <u>Inspection Requirements</u> <ul style="list-style-type: none"> • Throughout work activities 	Lightning strikes	<ul style="list-style-type: none"> • Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Minimize contact with the ground and keep body parts that must touch the ground as close together as possible.
<u>Training Requirements</u> <ul style="list-style-type: none"> • First Aid/CPR (American Red Cross) as required 	Thunderstorms, tornados	<ul style="list-style-type: none"> • Listen to the radio announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings as directed by field supervisor. • Seek shelter. Do not try to outrun a tornado.

**Hazard Analysis
Laboratory Operations**

General Physical Hazards	Potential Hazards	Control Measures
Equipment That May be Used: <ul style="list-style-type: none"> • XRF • Laboratory hood • Sieve • Safety glasses with side shields • Gloves • Steel-toed boots (as specified in the task plan) Inspection Requirements <ul style="list-style-type: none"> • Daily Training Requirements <ul style="list-style-type: none"> • Task-specific • Proper use and operation of stump chipper • First Aid/CPR training (American Red Cross) as required 	Slip, trip, fall Poor housekeeping	<ul style="list-style-type: none"> • Whenever possible, avoid routing cords, ropes, and hoses across walking pathways. • Work areas will be kept clean and orderly. • Garbage and trash will be disposed of regularly in approved refuse containers. • Tools and accessories will be properly maintained and stored. • Work areas and floors will be kept free of dirt, grease, and slippery materials. • Materials shall be stored to allow clear access to aisles, pathways, and travel routes.
	Burns from the oven and drying pans	<ul style="list-style-type: none"> • Wear gloves at all times when opening ovens and handling drying pans
	Injuries due to flying debris	<ul style="list-style-type: none"> • Inspect the equipment daily prior to use. • Ensure that all equipment is in good condition • Wear safety glasses when opening ovens and operating sieve
	Minor cuts and bruises	<ul style="list-style-type: none"> • Workers shall wear appropriate field attire (i.e., no tank tops, shorts, open-toe shoes, jewelry). • Tools not functioning properly shall be removed from service immediately and tagged for repair. • Worker shall wear cotton or leather work gloves when handling equipment. • Have at least one person onsite trained in First Aid/CPR.
	Exposure to airborne arsenic and lead	<ul style="list-style-type: none"> • Conduct all potentially dusty operations in the laboratory hood • Replace laboratory hood filters outdoors while standing upwind • Inspect the laboratory hood each day to ensure proper operation
	Exposure to x-rays	<ul style="list-style-type: none"> • Inspect instrument each day before operating • Instrument to be operated only by properly trained personnel • Operate instrument in accordance with operating manual • Do not bypass safety locks, interlocks, etc. • Repairs and maintenance shall be performed only by authorized personnel

Activity Hazard Analysis
Soil & Dust Sampling of Arsenic and Lead Contaminated Material

Arsenic Contaminated Material	Potential Hazards	Control Measures
<p><u>Equipment That May Be Used:</u></p> <ul style="list-style-type: none"> • Safety glasses with side shields • Steel-toed boots (as specified in the task plan) • Leather gloves • Long-sleeved shirts and long pants <p><u>Inspection Requirements</u></p> <ul style="list-style-type: none"> • Equipment: When first delivered to site, daily • Utilities: Prior to excavating <p><u>Training Requirements</u></p> <ul style="list-style-type: none"> • 40-hour basic HAZWOPER • 8 hour HAZWOPER refresher • 8 hour HAZWOPER supervisor (for supervisory personnel) • Task-specific • Arsenic and lead specific training • First Aid/CPR training (American Red Cross) as required 	<p>Health Hazard:</p> <ol style="list-style-type: none"> 1. Ingestion of arsenic and lead contaminated material 2. Inhalation of arsenic and lead contaminated material 	<ul style="list-style-type: none"> • Site workers will be required to wear gloves, safety glasses with safety shields, long sleeve shirts and long pants, and steel-toe boots when working in the field. • Workers are required to wash/clean their hands after finishing soil sampling activities in one area and before moving to the other area. Also, prior to eating, drinking, smoking, or chewing gum/tobacco. • Real time and time-integrated air sampling to be conducted daily when excavating arsenic contaminated soils. • Dust suppression to be initiated when airborne dust levels exceed 0.45 mg/m³ • Site workers will decontaminate their clothing and boots, as needed, prior to leaving the work area. • Sampling equipment will be decontaminated prior to leaving the work area. • All employees participating in the Vasquez Boulevard Remedial Investigation will be participate in a comprehensive medical surveillance program. Sputum Cytology and Urine Arsenic samples will be collected: Prior to initially starting work in arsenic contaminated areas, semi annual, annual and upon termination.
	<p>Physical Hazard: Transporting equipment and materials to job site</p>	<ul style="list-style-type: none"> • Use adequate blocking. • Comply with local speed limits. Utilize signalmen where necessary. • Only licensed drivers to drive vehicles • Be aware of personnel and residents when backing up or entering traffic • Perform daily equipment safety inspections.

APPENDIX J
TRAINING ATTENDANCE FORMS



SAFETY TRAINING MEETINGS

SAFETY TRAINING MEETINGS		
DATE OF TRAINING:	PROJECT NUMBER:	LOCATION:
CREW:	CRAFT(S):	
BRIEFLY DESCRIBE SPECIFIC TRAINING TOPICS COVERED		
1.		
2.		
3.		
4.		
5.		
TOTAL EMPLOYEES ON CREW(S):		TOTAL IN ATTENDANCE:

EMPLOYEES ATTENDING

Complete all sections fully and submit to the Project Safety Supervisor or Safety Representative		
SUPERVISOR:		TITLE:

APPENDIX K

NIOSH METHOD 7300 FOR
ARSENIC AND LEAD SAMPLING AND ANALYSIS

MW: Table 1

CAS: Table 2

RTECS: Table 2

METHOD: 7300, Issue 2

EVALUATION: PARTIAL

Issue 1: 15 May 1989

Issue 2: 15 August 1994

OSHA: Table 2

NIOSH: Table 2

ACGIH: Table 2

PROPERTIES: Table 1

ELEMENTS:	aluminum*	chromium*	lithium*	phosphorus	tellurium	zinc
	arsenic	cobalt*	magnesium	platinum*	thallium	zirconium*
	beryllium*	copper	manganese*	selenium	titanium	
	cadmium	iron	molybdenum*	silver	vanadium	
	calcium	lead*	nickel	sodium	yttrium	

* Some compounds of those elements require special sample treatment.

SAMPLING		MEASUREMENT	
SAMPLER:	FILTER (0.8- μ m, cellulose ester membrane)	TECHNIQUE:	INDUCTIVELY COUPLED ARGON PLASMA, ATOMIC EMISSION SPECTROSCOPY
FLOW RATE:	1 to 4 L/min	ANALYTE:	elements above
VOL-MIN:	Table 1	ASHING	
-MAX:	Table 1	REAGENTS:	conc. HNO ₃ , 4 mL; and conc. HClO ₄ , 1 mL
SHIPMENT:	routine	CONDITIONS:	room temperature, 30 min; 150 °C to near dryness
SAMPLE STABILITY:	stable	FINAL SOLUTION:	4% HNO ₃ , 1% HClO ₄ , 10 mL
BLANKS:	2 to 10 field blanks per set	WAVELENGTH:	depends upon element; Table 3
ACCURACY		BACKGROUND CORRECTION:	spectral wavelength shift
RANGE STUDIED:	not studied	CALIBRATION:	elements in 4% HNO ₃ , 1% HClO ₄
BIAS:	none identified	RANGE:	2.5 to 1000 μ g per sample [1]
OVERALL PRECISION (S_p):	not evaluated	ESTIMATED LOD:	1 μ g per sample [1]
ACCURACY:	not determined	PRECISION (S_p):	Table 3

APPLICABILITY: The working range of this method is 0.005 to 2.0 mg/m³ for each element in a 500-L air sample. This is simultaneous elemental analysis, not compound specific. An alternative microwave digestion procedure is included. Verify that the types of compounds in the samples are soluble with the ashing procedure selected.

INTERFERENCES: Spectral interferences are the primary interferences encountered in ICP-AES analysis. These are minimized by judicious wavelength selection, interelement correction factors and background correction [1,2].

OTHER METHODS: This method replaces P&CAM 351 [2] for trace elements. Flame atomic absorption spectroscopy (e.g., Methods 7000) is an alternate analytical technique for many of these elements. Graphite furnace AAS (e.g., 7102 for Be, 7105 for Pb) is more sensitive.

REAGENTS:

1. Nitric acid, conc., ultra pure.
2. Perchloric acid, conc., ultra pure.*
3. Ashing acid: 4:1 (v/v) HNO_3 : HClO_4 . Mix 4 volumes conc. HNO_3 with 1 volume conc. HClO_4 .
4. Calibration stock solutions, 1000 $\mu\text{g/mL}$. Commercially available, or prepared per instrument manufacturer's recommendation (see step 12).
5. Dilution acid, 4% HNO_3 , 1% HClO_4 . Add 50 mL ashing acid to 600 mL water; dilute to 1 L.
6. Argon.
7. Distilled, deionized water.

* See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: cellulose ester membrane filter, 0.8- μm pore size, 37-mm diameter; in cassette filter holder.
2. Personal sampling pump, 1 to 4 L/min, with flexible connecting tubing.
3. Inductively coupled plasma-atomic emission spectrometer, equipped as specified by the manufacturer for analysis of elements of interest.
4. Regulator, two-stage, for argon.
5. Beakers, Phillips, 125-mL, or Griffin, 50-mL, with watchglass covers.**
6. Volumetric flasks, 10- and 100- mL**
7. Assorted volumetric pipets as needed.**
8. Hotplate, surface temperature 150 °C.

** Clean all glassware with conc. nitric acid and rinse thoroughly in distilled water before use.

SPECIAL PRECAUTIONS: Perform all perchloric acid digestions in a perchloric acid hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Sample at an accurately known flow rate between 1 and 4 L/min for a total sample size of 200 to 2000 L (see Table 1) for TWA measurements. Do not exceed a filter loading of approximately 2 mg total dust.

SAMPLE PREPARATION:

3. Open the cassette filter holders and transfer the samples and blanks to clean beakers.
4. Add 5 mL ashing acid. Cover with a watchglass. Let stand 30 min at room temperature.
NOTE: Start a reagent blank at this step.
5. Heat on hotplate (120 °C) until ca. 0.5 mL remains.

NOTE 1: Recovery of lead from some paint matrices may require other digestion techniques. See Method 7082 (Lead by Flame AAS) for an alternative hotplate digestion procedure or the Appendix for a microwave digestion procedure [8].

NOTE 2: Some species of Al, Be, Co, Cr, Li, Mn, Mo, V, and Zr will not be completely solubilized by this procedure. Alternative solubilization techniques for most of these elements can be found elsewhere [2-7]. For example, aqua regia may be needed for Mn [4,9].

6. Add 2 mL ashing acid and repeat step 5. Repeat this step until the solution is clear.
7. Remove watchglass and rinse into the beaker with distilled water.
8. Increase the temperature to 150 °C and take the sample to near dryness (ca. 0.5 mL).
9. Dissolve the residue in 2 to 3 mL dilution acid.
10. Transfer the solutions quantitatively to 10-mL volumetric flasks.
11. Dilute to volume with dilution acid.

CALIBRATION AND QUALITY CONTROL:

12. Calibrate the spectrometer according to the manufacturers recommendations.

NOTE: Typically, an acid blank and 10 µg/mL multielement working standards are used. The following multielement combinations are chemically compatible in 4% HNO₃/1% HClO₄:

- a. Ag, Ca, Co, Mn, Pb, V, Zn;
- b. Al, Be, Cd, La, Li, Ni, Ti;
- c. As, B, Ba, Mg, Mo, P;
- d. Cu, Fe, Na, Pt, Sr, Te, Y;
- e. Cr, K, Se, Ti, Zr; and
- f. Si, W (distilled water only)

13. Analyze a standard for every ten samples.

14. Check recoveries with at least two spiked media blanks per ten samples.

MEASUREMENT:

15. Set spectrometer to conditions specified by manufacturer.

16. Analyze standards and samples.

NOTE: If the values for the samples are above the range of the standards, dilute the solutions with dilution acid, reanalyze and apply the appropriate dilution factor in the calculations.

CALCULATIONS:

17. Obtain the solution concentrations for the sample, C_s (µg/mL), and the average media blank, C_b (µg/mL), from the instrument.

18. Using the solution volumes of sample, V_s (mL), and media blank, V_b (mL), calculate the concentration, C (mg/m³), of each element in the air volume sampled, V (L):

$$C = \frac{C_s V_s - C_b V_b}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Method P&CAM 351 was evaluated in 1981 [1,2]. The precision and recovery data were determined at 2.5 and 1000 µg of each element per sample on spiked filters. The precision and recovery data, instrumental detection limits, sensitivity, and analytical wavelengths are listed in Table 3. The values in Table 3 were determined with a Jarrell-Ash Model 1160 ICP operated according to manufacturer's instructions.

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METHOD WRITTEN BY:

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James B. Perkins, David L. Wheeler, and Keith Nicholson, DataChem Laboratories, Salt Lake City, UT, prepared the microwave digestion procedure in the Appendix.

TABLE 1. PROPERTIES AND SAMPLING VOLUMES

Element (Symbol)	Properties		Air Volume, L @ OSHA PEL	
	Atomic Weight	MP, °C	MIN	MAX
Silver (Ag)	107.87	961	250	2000
Aluminum (Al)	26.98	660	5	100
Arsenic (As)	74.92	817	5	2000
Beryllium (Be)	9.01	1278	1250	2000
Calcium (Ca)	40.08	842	5	200
Cadmium (Cd)	112.40	321	13	2000
Cobalt (Co)	58.93	1495	25	2000
Chromium (Cr)	52.00	1890	5	1000
Copper (Cu)	63.54	1083	5	1000
Iron (Fe)	55.85	1535	5	100
Lithium (Li)	6.94	179	100	2000
Magnesium (Mg)	24.31	651	5	67
Manganese (Mn)	54.94	1244	5	200
Molybdenum (Mo)	95.94	651	5	67
Sodium (Na)	22.99	98	13	2000
Nickel (Ni)	58.71	1453	25	1000
Phosphorus (P)	30.97	44	50	2000
Lead (Pb)	207.19	328	1250	2000
Platinum (Pt)	195.09	1769	13	2000
Selenium (Se)	78.96	217	5	2000
Tellurium (Te)	127.60	450	25	2000
Titanium (Ti)	47.90	1675	5	100
Thallium (Tl)	204.37	304	25	2000
Vanadium (V)	50.94	1890	5	2000
Yttrium (Y)	88.91	1495	5	1000
Zinc (Zn)	65.37	419	5	200
Zirconium (Zr)	91.22	1852	5	200

TABLE 2. EXPOSURE LIMITS, CAS #, RTECS

Element (CAS #)	CAS #	RTECS	Exposure Limits, mg/m ³ (Ca = carcinogen)		
			OSHA	NIOSH	ACGIH
Silver (Ag)	7440-22-4	VW3500000	0.01 (dust, fume, metal)	0.01 (metal, soluble)	0.1 (metal) 0.01 (soluble)
Aluminum (Al)	7429-90-5	BD0330000	15 (total) 5 (respirable)	5	10 (dust) 5 (fume)
Arsenic (As)	7440-38-2	CG0525000	varies	C 0.002, Ca	0.01, Ca
Beryllium (Be)	7440-41-7	DS1750000	0.002, C 0.005	0.0005, Ca	0.002, Ca
Calcium (Ca)	-	-	varies	varies	varies
Cadmium (Cd)	7440-43-9	EU9800000	0.2, C 0.05 (dust) 0.1, C 0.3 (fume)	lowest feasible, Ca	0.01 (total), Ca 0.002 (resp.), Ca
Cobalt (Co)	7440-48-4	GF8750000	0.1	0.05	0.05 (dust, fume)
Chromium (II) (Cr)	22541-79-3	GB6260000	0.5	0.5	0.5
Chromium (III) (Cr)	16065-83-1	GB6261000	0.5	0.5	0.5
Chromium (VI) (Cr)	18540-29-9	GB6262000	C 0.1	0.001 (dust)	0.05 (soluble) 0.05 (insoluble), Ca
Copper (Cu)	7440-50-8	GL5325000	1 (dust, mists) 0.1 (fume)	1 (dust) 0.1 (fume)	1 (dust, mists) 0.2 (fume)
Iron (Fe)	1309-37-1	NO7400000	10 (dust, fume)	5 (dust, fume)	5 (fume)
Lithium (Li)	-	-	-	-	-
Magnesium (Mg)	1309-48-4	OM3850000	15 (dust) as oxide 5 (respirable)	10 (fume) as oxide	10 (fume) as oxide
Manganese (Mn)	7439-96-5	OO9275000	C 5	1; STEL 3	5 (dust) 1; STEL 3 (fume)
Molybdenum (Mo)	7439-98-7	QA4680000	5 (soluble) 15 (total insoluble) 5 (respirable insol.)	5 (soluble) 10 (insoluble)	5 (soluble) 10 (insoluble)
Nickel (Ni)	7440-02-0	QR5950000	1	0.015, Ca	0.05, Ca
Lead (Pb)	7439-92-1	OF7525000	0.05	<0.1	0.15
Platinum (Pt)	7440-06-4	TP2160000	0.002	1 (metal)	1 (metal)
Selenium (Se)	7782-49-2	VS7700000	0.2	0.2	0.2
Tellurium (Te)	13494-80-9	WY2625000	0.1	0.1	0.1
Titanium (Ti) TiO ₂	7440-32-6 13463-67-7	XR1700000 XP2275000	as TiO ₂ , 15 as TiO ₂ , 5 (respirable)	lowest feasible, Ca	10
Thallium (Tl)	7440-28-0	XG3425000	0.1 (skin) (soluble)	0.1 (skin) (soluble)	0.1 (skin)
Vanadium (V) V ₂ O ₅	7440-62-2 1314-62-1	YW240000 YW1355000	C 0.5 (respirable) as V ₂ O ₅ C 0.1 (fume) as V ₂ O ₅	C 0.05	0.05 (resp.) as V ₂ O ₅
Yttrium (Y)	7440-65-5	ZG2980000	1	1	1
Zinc (Zn)	1314-13-2	ZH4810000	5 (ZnO fume) 15 (ZnO dust) 5 (ZnO respirable)	5; STEL 10 (ZnO fume) 5; C 15 (ZnO dust)	5; STEL 10 (ZnO fume) 10 (ZnO dust)
Zirconium (Zr)	7440-67-7	ZH7070000	5	5, STEL 10	5, STEL 10

TABLE 3. MEASUREMENT PROCEDURES AND DATA ^(a).

Element	Wavelength (nm)	Instrumental LOD (ng/mL)	Sensitivity (Intensity/ $\mu\text{g/mL}$)	Recovery		Precision (\bar{S}_r) (N = 3)	
				@ 2.5 $\mu\text{g}/$ filter ^(b)	@ 1000 $\mu\text{g}/$ filter	@ 2.5 $\mu\text{g}/$ filter	@ 1000 $\mu\text{g}/$ filter
Ag	328.3	26	0.65	111	91	0.02	0.075
Al	308.2	14	0.23	93	100	0.092	0.023
As	193.7	13	0.57	103	99	0.062	0.026
Be	313.0	1.5	1.29	107	90	0.040	0.034
Ca	315.9	10	0.49	99	95	0.036	0.014
Cd	226.5	1.6	0.83	107	99	0.032	0.020
Co	231.2	7.4	0.38	101	95	0.040	0.005
Cr	205.6	1.3	0.50	98	106	0.053	0.016
Cu	324.8	2.1	0.72	98	99	0.036	0.022
Fe	259.9	3.9	0.13	94	97	0.068	0.016
Li	670.8	2.8	0.48	89	95	0.171	0.043
Mg	279.6	24	0.22	105	106	0.084	0.027
Mn	257.6	0.4	0.74	84	93	0.062	0.035
Mo	281.6	7.0	0.18	94	88	0.023	0.049
Na	589.0	10	0.76	(c)	101	(c)	0.045
Ni	231.6	3.4	0.41	105	97	0.027	0.020
P	214.9	22	0.17	(c)	91	(c)	0.056
Pb	220.4	17	0.42	105	95	0.060	0.011
Pt	203.7	15	0.69	106	91	0.041	0.075
Se	190.6	21	0.28	105	97	0.068	0.049
Sn ^(d)	190.0	64	0.49	74	67	0.33	0.16
Te	214.3	29	0.41	102	94	0.050	0.063
Ti	334.9	1.2	0.55	96	108	0.051	0.029
Tl	190.9	17	0.22	103	99	0.043	0.017
V	310.2	3.2	0.88	99	94	0.043	0.014
W ^(d)	207.9	13	2.58	35	23	0.053	0.60
Y	371.0	0.8	2.35	99	100	0.015	0.013
Zn	213.9	0.6	0.60	101	94	0.013	0.013
Zr	339.2	1.9	0.88	75	98	0.049	0.008

(a) Values reported were obtained with a Jarrell-Ash Model 1160 ICP; performance may vary with instrument and should be independently verified.

(b) 2.5 $\mu\text{g}/\text{filter}$ corresponds to 5 $\mu\text{g}/\text{m}^3$ for a 500-L air sample.

(c) Blank levels too high to make accurate determinations.

(d) Qualitative only because of low recovery.

APPENDIX - MICROWAVE DIGESTION FOR LEAD IN PAINT CHIPS (AND OTHER MATRICES)

This procedure is an alternative to the procedure presented in the Sample Preparation section of this method. It provides acid, complete acid digestion prior to analysis by flame atomic absorption (FAA), heated graphite furnace atomic absorption (HGFAA), and inductively coupled plasma spectroscopy (ICP) [10].

Apparatus and Material [11-16]**1. Microwave apparatus requirements**

- a. The microwave unit provides programmable power with a minimum of 574 W and can be programmed to within ± 10 W of the required power.
- b. The microwave unit cavity is corrosion resistant as well as ventilated. All electronics are protected against corrosion for safe operation.
- c. The system requires Teflon PFA digestion vessels (120-mL capacity) capable of withstanding pressures up to 7.5 ± 0.7 atm (110 ± 10 psi) and capable of controlled pressure relief at pressures exceeding 7.5 ± 0.7 atm (110 ± 10 psi).
- d. A rotating turntable is employed to ensure homogeneous distribution of microwave radiation within the unit. The speed of the turntable should be a minimum of 3 rpm.
- e. A safety concern relates to the use of sealed containers without pressure relief valves in the unit. Temperature is the important variable controlling the reaction. Pressure is needed to attain elevated temperatures but must be safely contained [12].
- f. Polymeric volumetric ware in plastic (Teflon or polyethylene), 50- or 100-mL capacity.
- g. Disposable polypropylene filter funnel.
- h. Analytical balance, 300-g capacity, and minimum ± 0.001 g.

Reagents

1. Nitric acid, concentrated, spectroscopy grade.
2. Reagent Water. Reagent water shall be interference free. All references to water in the method refer to reagent water that meets the ASTM Type 2 standard.

Procedure**1. Calibration of Microwave Equipment**

Calibrate microwave equipment in accordance with manufacturer's instructions. If calibration instructions are not available, see EPA Method 3051 [11].

2. All digestion vessels and volumetric ware must be carefully acid washed and rinsed with reagent water. All digestion vessels should be cleaned by leaching with hot (1:1) nitric acid for a minimum of fifteen minutes, rinsed with reagent water, and dried in a clean environment.
3. Sample Digestion
 - a. Tare the Teflon PFA digestion vessel.
 - b. Weigh out 0.1 g paint chip sample to the nearest 0.001 g into the tared Teflon PFA sample vessel. With large paint chip samples, measure out a 2 cm² piece, weigh to the nearest 0.001 g, and quantitatively transfer it to the vessel.

- c. Add 5.0 ± 0.1 mL concentrated nitric acid to the sample vessel in a fume hood. If a vigorous reaction occurs, allow the reaction to stop before capping the vessel. Cap the vessel and torque the cap to 12 ft-lb (16 N-m) according to the manufacturer's directions. The sample vessel may be connected to an overflow vessel using Teflon PFA connecting tubes. Place the vessels in the microwave carousel. Connect the overflow vessels to the center well of the unit.
- d. Place the vessels evenly distributed in the turntable of the microwave unit using groups of two, six, or 12 sample vessels. Any vessels containing 5 mL of nitric acid for reagent blank purposes are counted as sample vessels. When fewer than the recommended number of samples are to be digested, i.e., three samples plus one blank, the remaining vessels should be filled with 5 mL of nitric acid to achieve the full complement of vessels. This provides an energy balance since the microwave power absorbed is proportional to the total mass in the cavity [14]. Irradiate each group of samples to achieve a temperature of 180°C in five minutes at a pressure of 50 psi. Continue to irradiate to achieve a temperature of 180°C at 100 psi after 25 minutes. Continue digestion for five minutes. A sample digestion program for 12 samples is presented in Table 1.

Table 1

Program Variables for Paint Chips Sample Digestion with Nitric Acid

<u>Stage</u>	<u>(1)</u>	<u>(2)</u>	<u>(3)</u>
Power	90%	90%	0%
Pressure, psi	50	100	0
Run Time, min	10:00	20:00	05:00
Time @ P, min	05:00	15:00	00:00
Temperature	180°C	180°C	0°C
Fan Speed	100%	100%	100%
Number of Vessels:	12		
Liquid Volume per Vessel:	5 mL		
Sample Weight:	0.1 g		

If the analyst wishes to digest other than two, six, or 12 samples at a time, use different values of power as long as they result in the same time and temperature conditions.

- e. At the end of the microwave program, allow the vessels to cool for a minimum of five minutes before removing them from the microwave unit. If a loss of sample is detected (e.g., material in overflow collection vessel, liquid outside liner), determine the reason for the loss (e.g., loss of vessel seal integrity, use of a digestion time longer than 30 minutes, too large a sample, or improper heating conditions). Once the source of the loss has been corrected, prepare a new sample beginning at Section 2. If insufficient material is available for reanalysis, dilute remaining digestate and note that some sample loss may have occurred.
- f. Uncap and vent each vessel in a fume hood. Add 20 mL reagent water, then reseal vessels and shake to mix thoroughly. Transfer the sample to an acid-cleaned polyethylene bottle. If the digested sample contains particulates which may clog nebulizers or interfere with injection of the sample into the instrument, allow the sample to settle or filter it:

Settling: Allow the sample to stand until the supernatant is clear (usually, overnight is sufficient). If it does not clear, filter the sample.

Filtering: The filtering apparatus must be thoroughly precleaned and rinsed with dilute nitric acid. Filter the sample through quantitative filter paper into a second acid-cleaned container.

The digestate is now ready for analysis for elements of interest using the appropriate method.

4. **Calculations:** Report the concentrations based on the actual weight of the original sample.